DEC. 1953

Editorial

THE British Government has announced that the BBC will enter the field of commercial television, and has set up a £500,000 corporation to bring this about by the end of 1954

Commercial television in England however, won't be the same as commercial television in America. The BBC will operate the stations and rent time to advertisers, whereas in America the stations, all of which are commercial, are owned by interests other than the Government.

This announcement is one of great importance to Britain, and by inference to Australia. To-date the BBC has been meticulous in separating its activities from any suggestion of advertising. It has existed entirely on the revenue from licence fees, and the profits from its publications.

Frequent suggestions have been made at various times that the BBC should accept radio advertising to help balance the budget. None of these has so far borne fruit, but apparently in the case of television the BBC feels unable to plan any further without extra revenue to supplement TV licence fees.

This is not surprising, and has been forecast more than once by competent observers. The cost of maintaining high class TV programs all the year round is extremely high, and must increase still further. Even the huge advertising backing available for American programs hasn't been adequate.

Radio advertising isn't unknown to English listeners, for some European stations use it. No doubt the BBC has often realised the anomaly of its own position as stations outside its shores collect revenue which would have been welcome in its own coffers.

If Britain cannot pay for its television services from licence fees alone, can we in Australia do any better? We have in many ways a harder path to tread—our audiences will be smaller and more widely scattered, our technical costs on a comparative basis are not likely to be lower, and we have to start completely from scratch without any equipment obtained in less costly days. It may be that the BBC will end up with the most practical answer of all from a financial angle at least.

As forecast last month, however, there seems little likelihood of any early decisions in Australia. It has now been announced that the TV Commission's report is not due before May of next year — twelve months after it was expected. We will probably see the BBC's new venture in operation before any decisions are made on our own.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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VOL. 15 No. 9

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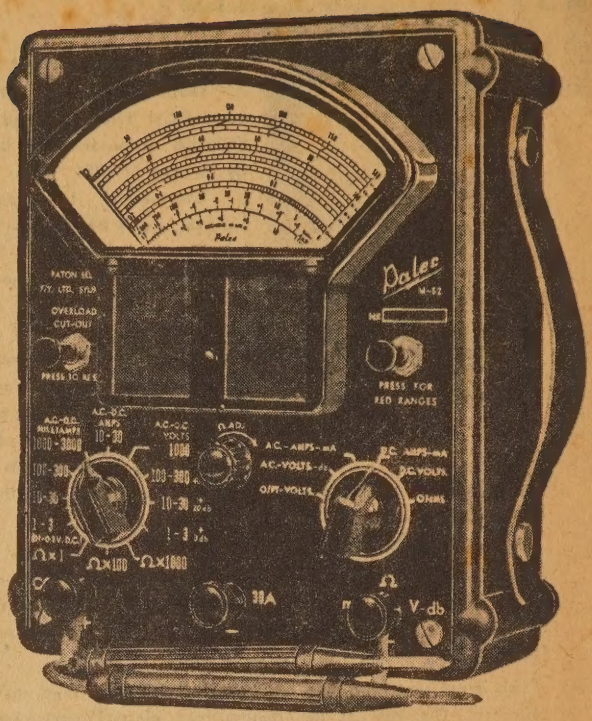

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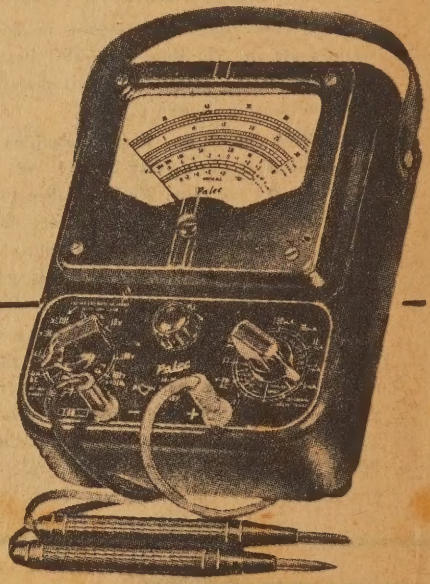

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RADIO FOR SHIPWRECKED CREWS

RCA Radiomarine's new portable lifeboat radio is demonstrated by cadets of the US Merchant Marine Academy, Kings Point, NY. Two cadets in the centre are cranking the 60lb emergency send-receive unit which is topped by a 15ft antenna mast. (See story on page 13.)

WONDER MACHINE MAKES RADIOS

Interior of MDE pilot plant, National Bureau of Standards shows automatic machine replacing lines of wires and assemblers. A few non-skilled technicians supervise machine's operation.

This article describes a revolutionary method of radio manufacture in which an automatic machine replaces the assembly line and a series of punched cards sets up the circuit to be wired. It is particularly applicable to mass production of small, complex units. Manufacturing methods of this type may be the only way to solve the problem of economically and speedily producing modern specialised electronic equipment.

by Robert Hartnell

M.D.E. (Modular Design of Electronics) is a new and revolutionary system of production, which, in a single assembly line operation, automatically fabricates complete electronic units from raw materials at an amazingly rapid rate. More commonly known by its code designation, "Tinkertoy," a name derived from its likeness to a child's construction outfit, the system was developed by the United States Navy in co-operation with the National Bureau of Standards.

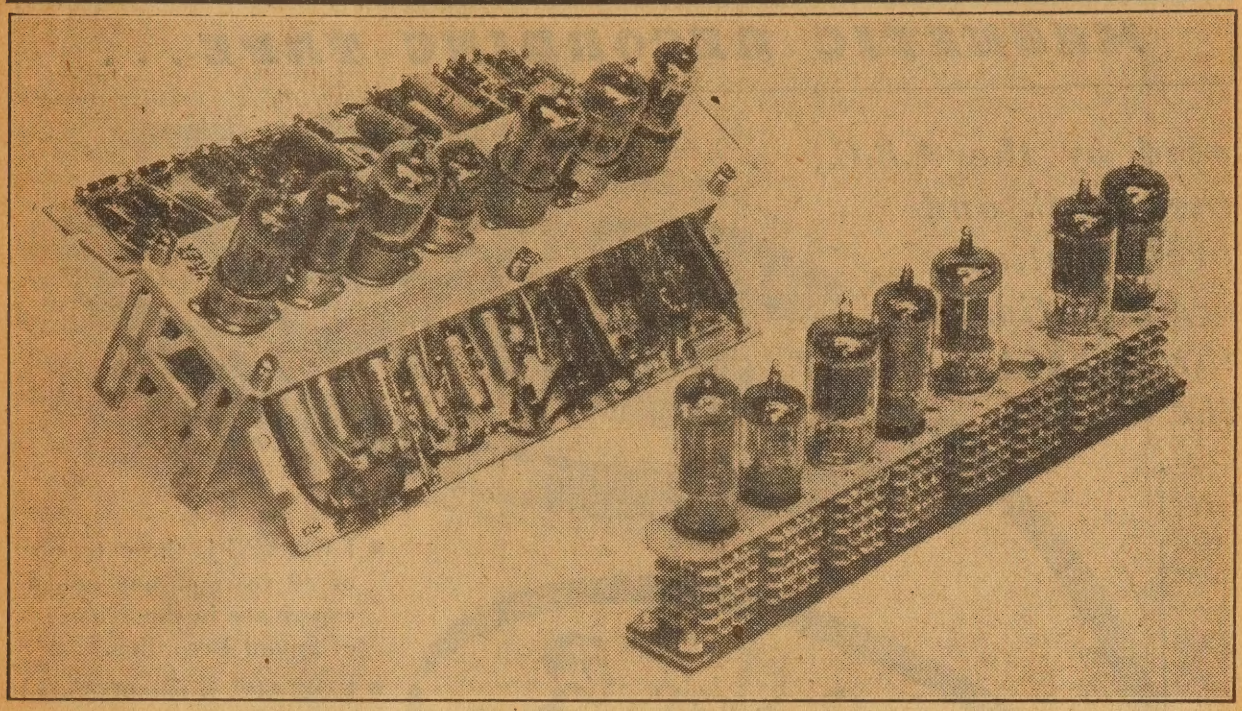
A gauge of its possibilities has been shown in the pilot plant (which resembles a bakery more than the conventional radio factory), where thirty-five unskilled technicians made as many sonar-buoy devices in one day as 1200 technicians would have made by the usual method of assembling and soldering separate component parts.

The basic "modular" unit in the Tinkertoy system is a ceramic wafer of steatite, 7-8 inch square, with three notches equally spaced on each side. On the two faces of the wafers are machine-assembled resistors, capacitors, inductors and valve sockets. The sockets are conventional, but the other components are a development of printed circuits.

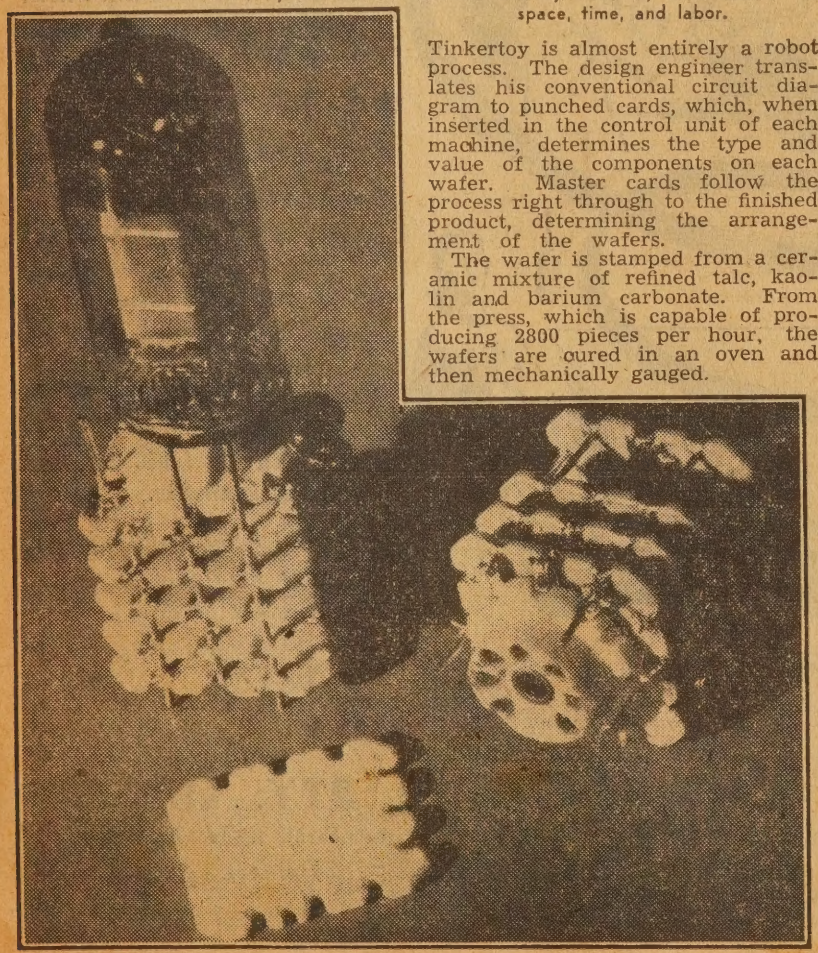
A series of four to six of these wafers, when stacked one above the other, notches aligned and conductors fitted, interlock into a wide variety of circuit arrangements, the wire conductors also serving as structural supports. Such a stack is known as a "module" and represents a stage in an electronic circuit. A number of modules combine to form a complete unit.

From the weighing and testing of basic raw materials to the accurate inspection of the assembled unit,

AUTOMATICALLY AT HIGH SPEED



A Radio Altimeter made by conventional methods and by Tinkertoy construction. The new method represents a vast saving in space, time, and labor.



Tinkertoy is almost entirely a robot process. The design engineer translates his conventional circuit diagram to punched cards, which, when inserted in the control unit of each machine, determines the type and value of the components on each wafer. Master cards follow the process right through to the finished product, determining the arrangement of the wafers.

The wafer is stamped from a ceramic mixture of refined talc, kaolin and barium carbonate. From the press, which is capable of producing 2800 pieces per hour, the wafers are cured in an oven and then mechanically gauged.

The capacitors are produced in much the same manner. They are approximately a half inch square, and .1002 of an inch thick. Their capacities vary from 7 mmfds to .01 mfds to a very close tolerance.

Resistors are first produced in strips of heat resistant asbestos tape. These tape resistors have a range of from 10 ohms to 10 megohms. They can hold their rated resistance within plus or minus 10 pc up to temperatures near 400 degrees F, and are rated at ¼ watt.

Printing of circuits, dip soldering and joining is accomplished through photographic masters which, in turn, are controlled by the punch cards.

Performance of equipment produced by the Tinkertoy system is reported equivalent to that obtained from conventional manufacture. Tests in shock, vibration, temperature and humidity meet stringent military requirements.

In the event of component failure, the complete module is easily and quickly replaced.

Defence chiefs are anxious that industry develop Modular Design for all types of electronic equipment and are making full information available. Their interest and enthusiasm lies in their belief that Tinkertoy can overcome the bottleneck of skilled factory workers in the event of an emergency.

Left—an assembled module with valve inserted—a primary wafer below. At the right a module lies on its side to show the valve socket.

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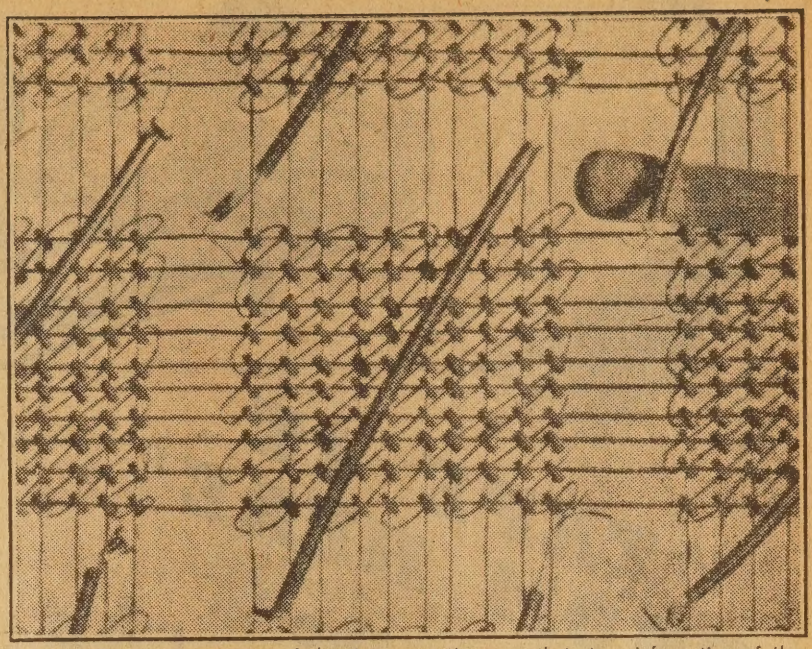
NEW AID FOR ELECTRONIC BRAIN

Modern electronic computors, popularly known as electronic "Brains", have one vital requirement—they need some device which will record the answer to one section of a problem and "store" it until it is required to be taken back into the calculation as a whole. Such a device is often called a "memory" and methods for obtaining the necessary electrical time delay have given engineers much thought.



Enlarged view of a section of the tiny magnetic cores that store information of the kind used in electronic computors show their size relative to the head of a paper match, seen at the right.

BEFORE a problem is fed into a computer it must first of all be simplified by a mathematician into a series of steps, the answers to which will be yes or no, plus or minus, current or no current.

It is essential, therefore, that some method be employed to record the answers to certain steps, to hold them while subsequent operations of the computor are carried out, and to feed the delayed answer back into the chain at the appropriate time. Preparing the problem for presentation to the computor requires special mathematical skill, and often takes much longer than the computor requires to do its part.

This storing of an answer requires an electrical delay of some kind, good for a duration of an appreciable period. Various methods including lengths of recording tape, mercury lines, &c., have been used, most of which are awkward and bulky.

Recently several new forms of electrical "memory" have been developed specifically for computor work in an endeavor to achieve flexibility, reliability, a large number of co-ordinated "memories" in a small space, and easy maintenance and installation.

One of these, developed by the Bell Telephone Laboratories, uses crystals of barium titanate, a material developed during World War II. Only a few thousandths of an inch thick, the flat crystals will receive and hold tiny charges which represent the answers the machine will ask for later on. A plus charge means "yes"—a negative "no".

Words, sentences, or a series of numbers can be coded by using a large number of these symbols, just as a punched piano roll can represent music. The roll plays or silences any note by the presence or absence of air pressure — the computor uses electrical pressure.

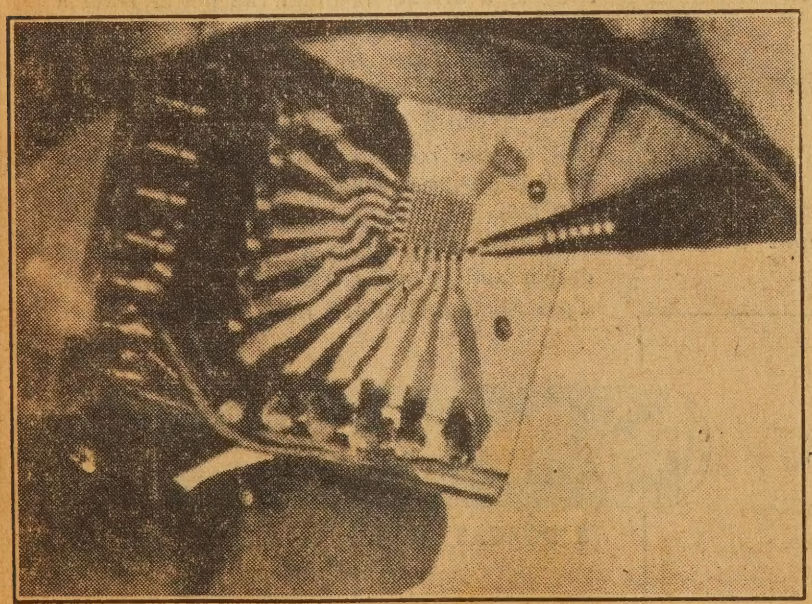
The sensitive atoms of barium titanate show remarkably quick response to the slightest changes in temperature, pressure, or electrical field. Even light changes are recorded.

Another memory device designed by RCA is represented in a machine by 10,000 tiny ring-shaped magnets woven into a netting of wires. Current flowing through the wires magnetises the tiny rings so that 10,000 items of information can be recorded and stored in an instant. The magnetism is used to produce a small current in the wires when the time comes to refer back to the stored answers.

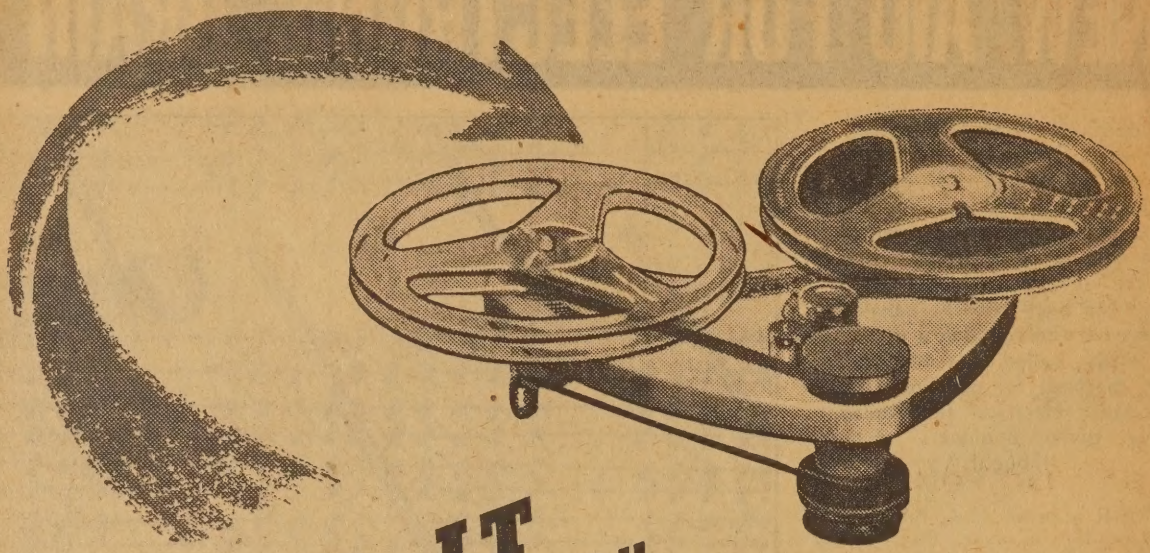
The speed with which the process takes place is claimed as an important feature of the system, for older methods involving such storage are comparatively slow in action. Remember that the times involved are so small as to be measured in millionths of a second if the essential speed of the computor is to be preserved. RCA's storage time is indefinite, but its action cycle is almost instantaneous.

The speed of some of the latest

(Continued on Page 11)



Tiny crystals a few thousandths of an inch thick, made of barium titanate, can remember bits of information for an indefinite period. The fine electrodes carry the information, as electrical charges, to the crystals.



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BRITAIN USES POWER OF WIND

Britain's natural resources of energy for the production of electricity are exhaustible, and are being expended at alarming rate. Demand for electricity is sky-rocketing. The corresponding annual consumption of coal and oil is far above the level that estimated reserves can be expected to maintain. The time has come when some new energy for generating electricity must be harnessed. Engineers are therefore casting round for new, inexpensive methods of producing power.

BY TREVOR HOLLOWAY

WATER power schemes have limitations in Britain. Although nuclear energy is being developed for power production its eventual economy and range of application are as yet uncertain.

So Britain is becoming "windmill-minded" once more. Not in terms of the old-time posts and smock-mills, of course, but in favor of a completely modernised version which has been aptly described as a windmill turned inside out.

Power is not generated by linking a generator directly to the revolving blades, but by an indirect method of greater efficiency using the turbine principle.

In Britain a stiff breeze is always blowing somewhere or other. If a sufficient number of generating plants were erected on selected hilltops up and down the country, some, if not all, would be operating at any given time, and their electrical output could be fed into the national grid scheme. Individually, output would be small, but collectively they would pour a considerable amount of electricity into the common pool. It has been estimated that 500 plants each with an output of 100 kw, would save Britain two million tons of coal annually.

STORAGE PROBLEM

Feeding current direct into the grid system would obviate the complex and very costly business of storage. Furthermore, during the winter months when the maximum demand for heating and lighting prevails, the maximum number of the hilltop plants would be turning merrily in the strongest seasonal winds.

In April, 1949, the British Electricity Authority invited tenders for the design, manufacture and setting to work of an Experimental Wind-Driven Electric Generator of 100 kilowatts capacity.

By the end of 1949 the firm of Enfield Cables Ltd. was able to offer such a machine to the BEA and their acceptance was made public at the plenary meeting of the World Power Conference of 1950. Co-operating with Enfield were de Havilland Propellers Ltd., and the English Electric Co. Actually, the machine was designed from first principles by de Havilland and has been largely constructed in their works. The tower was constructed by the Redheugh Iron and Steel Co.

It was no easy task to determine the type of machine on which to concentrate. In designing a plant of the size demanded by the BEA, there was little past experience on which to base future requirements. Small direct - driven generators such as used for farms and isolated homesteads having outputs of up to 5 kw provided no useful data. Some knowledge was gleaned from Denmark where a series of plants had been erected which had generators geared direct to a propeller at the top. Data was also obtained from the USA of a similar type experimental plant with an output of 1250 kw, but this plant was wrecked by a gale during early trials and the project abandoned.

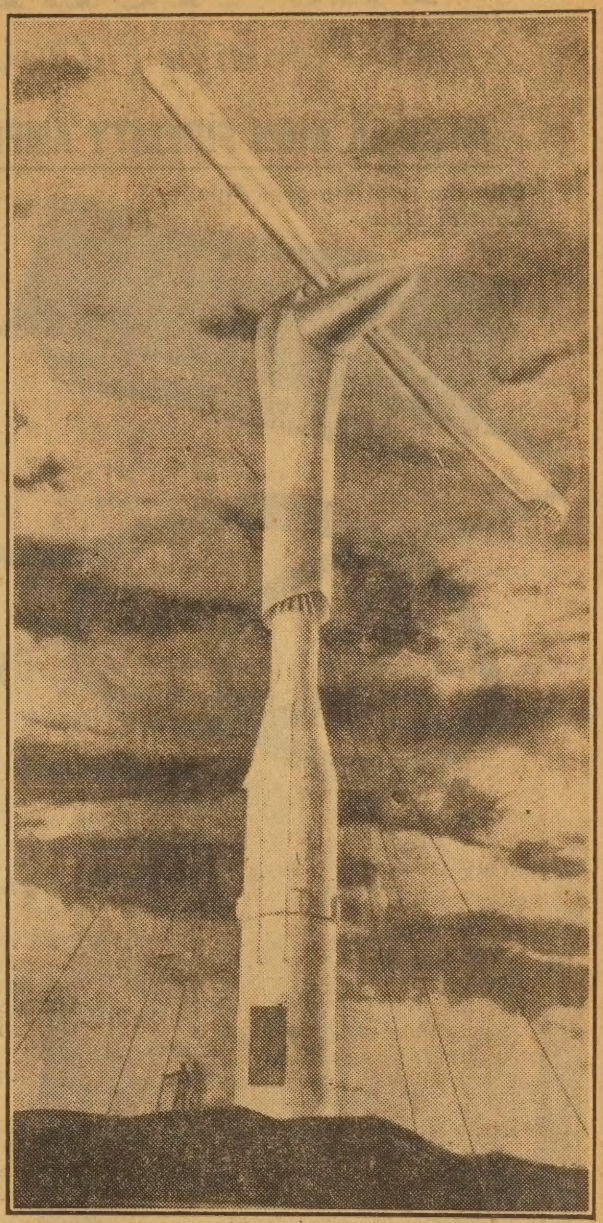
NEW PRINCIPLE

The designers adopted the "depression" principle then being tested on a small scale by Monsieur J. Andreau, in France. It was a system whereby the generator could be mounted at ground level with no need for gearing between it and the propeller.

Work then proceeded apace and at the time of writing the prototype Enfield 100 kw anemo-electric power plant is being set up on a site at Prae Wood, in Hertfordshire. After extensive trials it will be transported to an approved site on the Caernarvonshire coast, Wales.

The plant consists of a 100ft tower of stressed steel plate and girder construction, circular in section and decreasing in diameter from 9ft at the base to 3ft 6in at the top where it enters the hub structure. The hub is mounted on roller bearing and rotates about the axis of the tower as the propeller orients into the wind.

The propeller has two aluminium blades of hollow construction with a



This picture shows the giant windmill with a sweep of 80ft. Note the openings at the blade tips through which the air is sucked up the column past the turbine.

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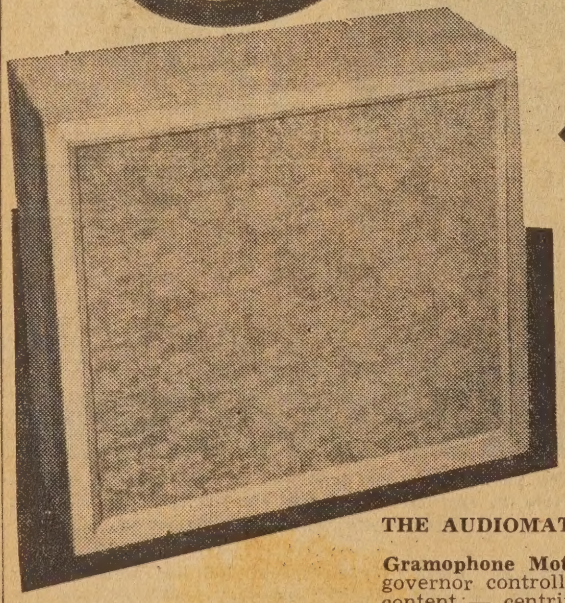

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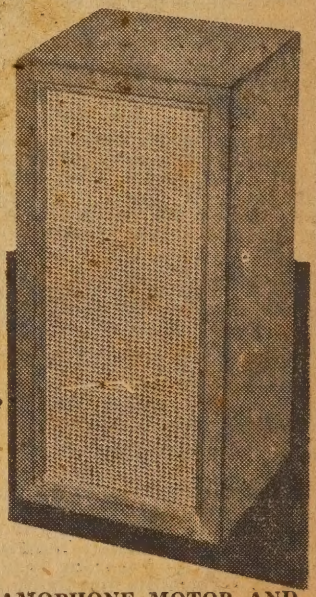

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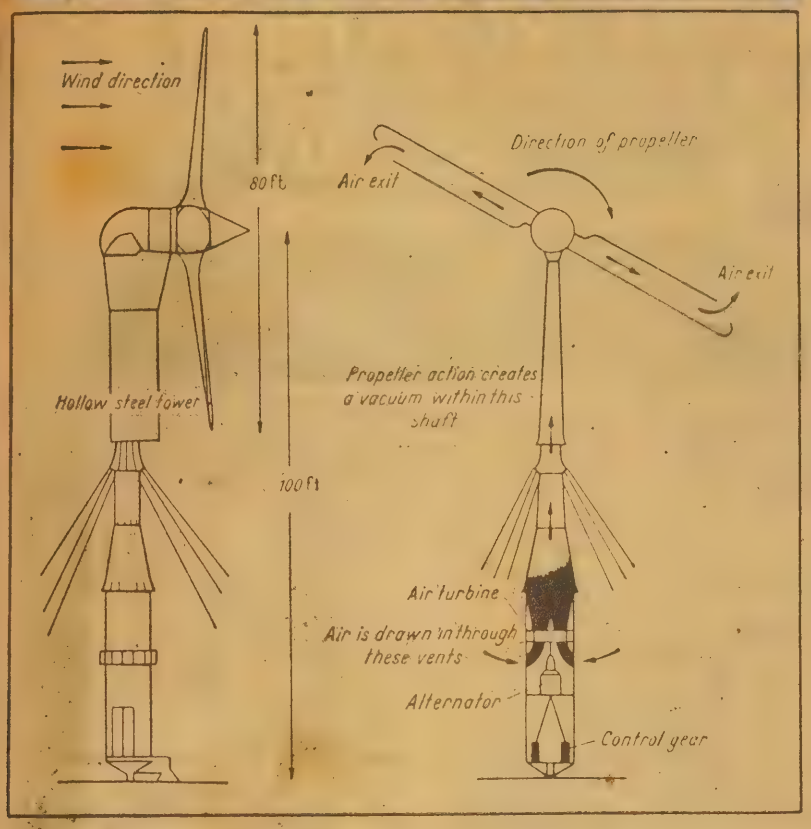
WINDMILL USES NEW PRINCIPLE



Details of the 100Kw Enfield machine.

swept circle diameter of 80ft. As the propeller rotates in the wind, the air within the blades is forcibly ejected, being literally sucked out by the reduced pressure at the blade tips.

This creates a vacuum or "depression" within the tower which sucks air in the shaft and through a turbine driving an alternator. It is therefore secondary wind that is directly employed instead of a primary wind force as in the case of the conventional direct-geared plants of the 5kW type.

The pitch of the propeller is adjusted automatically by a hydraulic system so that the rotational speed remains constant in winds of 30 to 65 mph, above which the plant shuts down. Output increases from zero at a wind speed of 17 mph up to 100 kW at 30 mph.

SEVERE CONDITIONS

From the outset it has been appreciated that any plant erected would have to face up to the most severe climatic conditions owing to the necessity for sitting in exposed situations. Accordingly, no effort has been spared to guard against metallic corrosion. Outer and some inner surfaces have been treated with sprayed aluminium metal or to specifications based on the combined experience of the British Admiralty and leading civil authorities.

Already some seventy possible sites have been tested and approved. If the 100 kW plant is a success the BEA will be justified in going ahead with larger plants of up to 1000 kW.

The Electrical Research Association have suggested that suitable sites for wind-driven generators are those which are windy enough to produce a minimum of 4000 kW hours of energy per annum from each kilowatt of capacity installed. The BEA have also expressed the opinion that a suitable plant might have a generation cost of .25d. per kW hour, which compares favorably with a figure of approximately 4d. in relation to steam power station generation.

CHEAPER POWER

In other words, cheaper power without burning an ounce of coal. On the face of it, Britain would seem to be backing a winner— but it all depends on what sort of performance this windmill with the New Elizabethan look puts up when finally installed on that hilltop in Wales.

CIGARETTE HAS BUILT-IN MATCH

THE cigarette of tomorrow may come complete with a built-in match. When rubbed against an abrasive surface, a "fire capsule" in one end of the cigarette bursts into flame.

The invention is designed to provide smokers with a cigarette that can be lighted easily, even in foul or windy weather. Upon being struck, the fire capsule forces the small blaze into the tobacco.

BBC ORDERS NEW TV TRANSMITTERS

WORLD'S MOST POWERFUL

The BBC has ordered both vision and sound transmitters from Marconi's Wireless Telegraph Co. Ltd. for the new London television station at Crystal Palace which will replace the existing station at Alexandra Palace. The new station will take about two years to build.

WHEN completed, the Crystal Palace will be the world's most powerful television station operating in the frequency band 42-88 mc/s. It will also be the first time television transmitters have been used in parallel—on the same principle as the third program transmitters which have been successfully operated for more than two years at Daventry.

The coverage given by this station is expected to be much larger than Alexandra Palace and will bring some of the existing "fringe" areas into full range.

Crystal Palace will have two 15 kilowatt vision transmitters designed for parallel operation with a combined output of 30 kilowatts. The effective radiated power of this station is expected to be between 200 and 250 kilowatts, which is twice that obtained from any of the existing regional transmitters. In order to achieve this, the BBC will, for the first time, use a high gain aerial system, thereby utilising a transmitter output power which is only 60 pc of the regional transmitters.

The BBC are also, for the first time, using television transmitters in parallel. Although existing standards of reliability and service are high, this arrangement results in an even higher standard since the failure of one of the transmitters results only in the lowering of the radiated power and not a complete shut-down of the station.

NEW AID FOR ELECTRONIC BRAIN

(Continued from Page 7)

computors is reported as being fantastic.

One machine, the "Oracle," designed for use at Oak Ridge, can receive, retain, and process 2048 twelve-digit numbers. It can "memorise" 4-million words, and it can multiply 999,999,999,999 by the same enormous number in less time than it takes a person to bat his eye.

Although the crystals, and other methods, seem to have remarkable remembering power, particularly when interconnected in large batteries, they do not begin to approach the ability of the human brain to store and use reactions. Electronic equipment of the latest design which would even estimate the power of the brain would occupy all the space of a vast building, and prove almost impossible to control. Even so, it would require to be actuated—the brain can think and originate, the machine of itself cannot.

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TYPE	PRIMARY	mA	H.T. VOLTS	FILAMENT RATINGS			MOUNTING	RETAIL PRICE
U30/150	230/240	30	150/150	6.3v/1.7a			Midget Upright	29/7
U or F40/150	"	40	150/150	6.3v/2a			Upright or Flat	39/9
U or F40/285	"	40	285/285	6.3v/2a	5v/2a		Upright or Flat	44/-
U or F40/325	"	40	325/325	"	"		Upright or Flat	45/6
U or F50/225	"	50	225/225	6.3v/2a			Upright or Flat	44/9
U or F60/285	"	60	285/285	6.3v/2a	5v/2a		Upright or Flat	53/2
U or F60/325	"	60	325/325	"	"		Upright or Flat	54/1
U or F60/385	"	60	385/385	"	"		Upright or Flat	58/3
U or F80/285	"	80	285/285	6.3v/2a	6.3v/2a	5v/2a	Upright or Flat	60/10
U or F80/325	"	80	325/325	"	"	"	Upright or Flat	62/4
U or F80/385	"	80	385/385	"	"	"	Upright or Flat	65/5
U or F100/285	"	100	285/285	6.3vct/2a	6.3v/2a	5v/2a	Upright or Flat	67/6
U or F100/325	"	100	325/325	"	"	"	Upright or Flat	69/-
U or F100/385	"	100	385/385	6.3vct/2.5a	6.3v/2a	5v/2a	Upright or Flat	76/5
U or F125/285	"	125	285/285	6.3vct/2a	6.3v/2a	5v/2a	Upright or Flat	85/4
U or F125/325	"	125	325/325	"	"	"	Upright or Flat	86/11
U or F125/385	"	125	385/385	6.3vct/2a	6.3v/2.5a	5v/3a	Upright or Flat	95/9
U or F150/285	"	150	285/285	"	"	"	Upright or Flat	89/8
U or F150/325	"	150	325/325	"	"	"	Upright or Flat	96/7
U or F150/385	"	150	385/385	"	"	"	Upright or Flat	111/11
* T80/250	"	80	250/250	6.3v/2a	5v/2a		Upright	60/-

* Low Field Tape Recorder Transformer. Other types available on request.

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B.14/60	14	60	520	13/9
C.20/60	20	60	500	25/5
D.30/60	30	60	600	45/-
C.15/80	15	80	430	42/11
E.20/80	20	80	300	45/-
E.30/80	30	80	380	48/5
F.15/100	15	100	300	45/-
F.15/125	15	125	250	59/-
F.15/150	15	150	200	67/-

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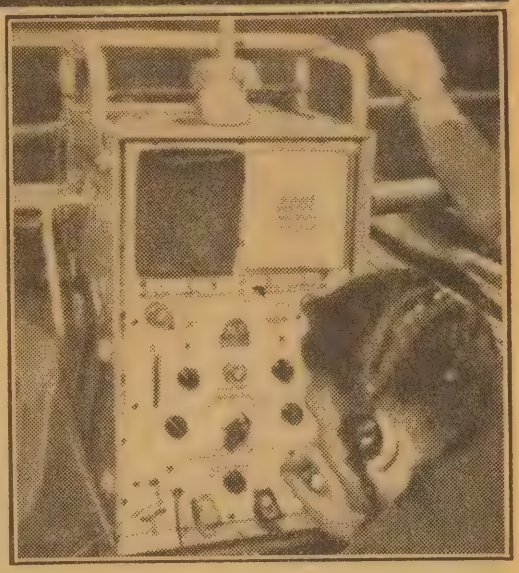
NEW PORTABLE LIFEBOAT RADIO

To be at all satisfactory an emergency lifeboat transmitter must be able to meet many exacting requirements. Here are details of the latest RCA Radiomarine equipment developed to meet current Safety Convention requirements.

BY IRVING BYRNES



In this close-up picture (right) a Merchant Marine cadet shows how telegraph key is pressed to send appeals for aid manually, as others in lifeboat generate power by cranking handles at the sides of the radio unit. The early version of a Radiomarine lifeboat radio pictured below weighed 15 pounds and used helium filled balloon to lift and support the antenna. This idea does not satisfy requirements of complete portability as a self-contained unit.

BROADLY, defined, a modern lifeboat radio set is a completely self-contained radio-telegraph station, which, in an emergency, can be transferred from a stricken vessel into a lifeboat, to serve there as a means of contact with land, other ships or rescuing parties. In the newest Radiomarine version, the set comprises a metal container, less than two cubic feet in volume, in which are nested a two-frequency transmitter and receiver, an automatic keyer, a hand generator for power supply and all necessary material for an antenna system.

The weight of the complete set is under 60 pounds and it is built to withstand a 20-foot drop into the sea from a ship's deck. Naturally, it is watertight and buoyant.

To operate the station, the container is first lashed to a thwart of the lifeboat and the antenna system assembled, after which the portable unit is ready to perform its lifesaving functions.

AUTOMATIC SOS

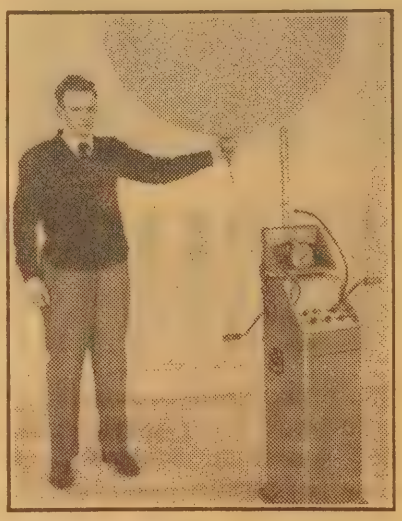
Several features are built into the Radiomarine equipment to make it possible for those unfamiliar with the telegraph code to operate it effectively. These features include automatic transmission of alarm signals and SOS signals on the distress frequency of 500 kc, followed by more SOS signals and a long dash on 8364 kc.

A period of about two minutes is required for this group of signals which are repeated over and over as long as the generator is being cranked. Besides automatic operation there are provisions for normal two-way communication whereby the radio receiver can be switched on for either frequency.

There were a number of interesting problems that required solution in designing this equipment. One of these is the hand generator used as the power supply. Here is a case where manpower, in the literal sense, is the basic source of energy.

The first step is to convert this manpower into horse-power. Previous experience with the design of hand generators has shown that one-eighth of a horsepower is about the maximum that should be demanded. This is roughly equivalent to a force of nine pounds on each handle at a cranking speed of 65 revolutions per minute. One able-bodied man can withstand such a load for about four or five minutes. In most cases two men will crank simultaneously, one on each crank. This, of course, results in much less fatigue and a longer operating period.

The energy applied to the generator cranks is equal to about 90 watts. The generator delivers an output of



50 watts. The difference of 40 watts is consumed as losses in the generator itself and in the gearing, bearings and so forth. This may appear to be low efficiency, but it is typical for a small, carefully designed machine of this class.

The radio transmitter has only four tubes. The power delivered to the antenna is about two watts on 500 kc and five watts on 8364 kc. Having two frequencies enables both short-distance and long-distance communication to be obtained.

AUTOMATIC KEYING

An important part of the transmitter is the automatic keying mechanism, a motor driven device which opens and closes various switches. It might be called the mechanical "brain" of the transmitter. It has a "memory" of 120 seconds and, parrot-like, will repeat its message every two minutes as long as the hand generator is cranked.

One complete group of signals may be described as follows: On 500 kc, the auto alarm signal is transmitted for 60 seconds. This comprises a series of a dozen four-second dashes, separated by spaces of one second duration. At the end of the alarm signal—and still on 500 kc—the SOS signal is transmitted three times within a period of fifteen seconds.

The keying device, in less than one second, now switches the circuits to 8364 kc. Three SOS signals are sent out on this frequency followed by a long dash lasting 30 seconds. Transmission then reverts to 500 kc, and the sequence is repeated.

Two-way communication with the lifeboat set requires, of course, that the radio receiver be switched into the circuits. For two-way service the receiver may be used for the 500 kc or the 8364 kc bands. It is fix-tuned for the band 492 to 508 kc and is also tunable from 8250 to 8750 kc. Novel circuits have been developed so that several functions are performed by only three conventional tubes.

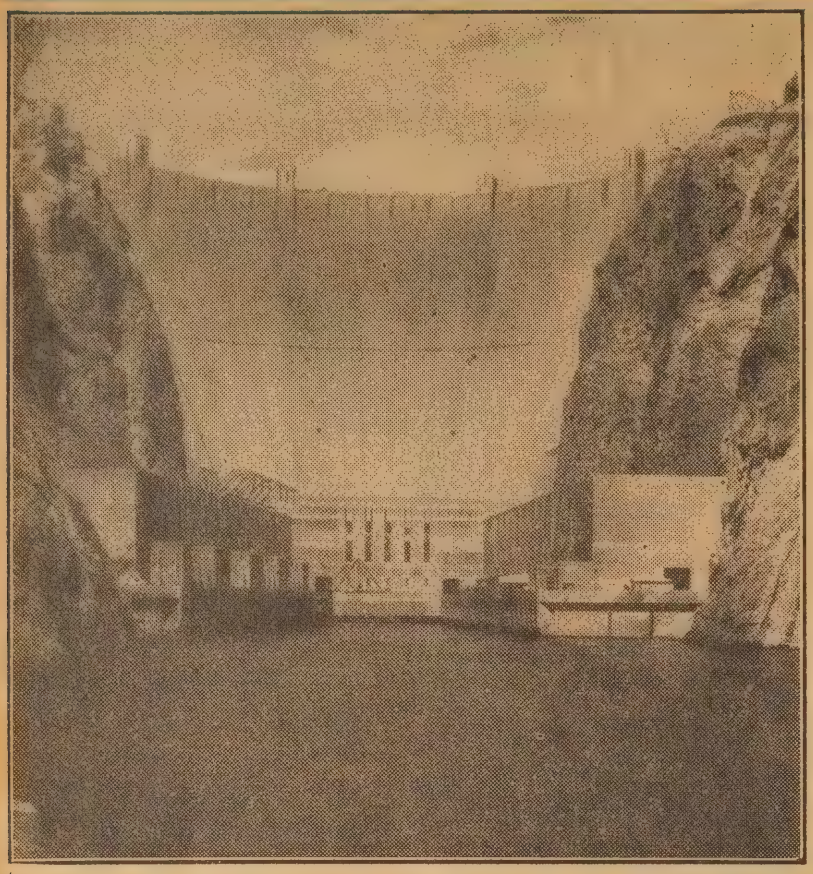
SIMPLE RECEIVER

For the 500 kc band the receiver is a simple two-stage radio-frequency amplifier followed by a germanium diode detector and a combined audio amplifier and beat frequency oscillator. For the eight megacycle band the receiver becomes a tunable superheterodyne with a 500 kc intermediate frequency amplifier.

One problem which is peculiar to a portable set for life-boats is the antenna system. During World War II lifeboat antennas were supported by the sailing mast, by kites or by balloons. Such arrangements are generally not compatible with the concept of self-contained portability. The 1948 Safety Convention specified a self-supported antenna or one supported by the lifeboat mast. Since some of the newer lifeboats do not have masts, optional arrangements are desirable as an integral part of the radio equipment.

In the Radiomarine set, the basic radiator is a sectionalised aluminium

(Continued on Page 23)



This huge dam is impressive by man's standards, but a mere pigmy against the Grand Canyon's natural sculpture. Dams like this harness water power for conservation and power generation.

WATER IS ESSENTIAL TO LIFE

Two essential substances which make life on earth possible are oxygen and water. Without these nothing could live. The earth would be a barren waste like the moon. This article talks about water, how much there is of it, how it has affected the earth's surface, and what man has done to harness its potential power for his own use.

by Calvin Walters

THERE are many important and interesting facts concerning the distribution of water. It is the purpose here to draw readers' attention to some of the most important and not so well known facts concerning this most remarkable substance.

Water assumes many forms. Firstly there is rain. This important phenomenon is that on which our water supplies depend and which replenishes our dams, rivers and lakes.

Then, of course, we have water in the form of ice. This is water at 0 degrees Centigrade. When we go to the other extreme and boil water it takes the form of steam. Condensed water vapor in the air becomes cloud. Then there is the familiar mist and fog.

DEW AND FROST

Dew is caused by water vapor condensing by contacting a cold surface. When this dew freezes it is called frost. Snow is another form of water, resulting from the freezing of the water in the air. A mixture of rain and snow is called sleet. Thunderstorms produce hail, which is formed by strong currents of air carrying the water drops into the higher atmosphere, where they become frozen.

Other forms of water can be called to mind, such as cabbage water, dirty water, barley water, dill water, bath water, washing-up water. Then there is the water with a drop of milk in it, delivered by the milkman and the water sometimes called soup sold in some cafes, together with water sometimes called tea, but all these have nothing much to do with our subject and are mentioned only in passing.

A DRY SUBJECT!

When my son, young Calvin, saw me typing this article, he said, "What a dry subject!" How water can be dry is something which science has not explained. Dry ice, of course, is dry, but then it is not ice, either, and it's not water, so there we are. Or are we?

We don't worry a great deal about the chemical characteristics of pure water for this is fairly widely known. Rather will we deal with the tremendous effect which water has on the earth in general.

Certain calculations have been made by enthusiastic workers, notably Sir Cyril S. Fox, of India, who wrote a whole book on the subject of water.

VAST WATER EXPANSE

Here are some of his remarkable "rough" estimates:—

There are 3600 cubic miles of water in the atmosphere below an altitude of 7000 feet. This is enough to cover the surface of the earth to a depth of 1.16 inches.

There are 315-million cubic miles of water in all the oceans and seas, and if the land was levelled along the floor of the sea this is enough water to cover the surface of the earth to a depth of 9000 feet and approximately 600 feet above mean sea level.

Ice caps and glaciers cover an area of 8-million square miles to a depth of approximately 528 feet average. There is enough water in these to give 800-thousand cubic miles, which would cover the surface of the earth to a depth of 21½ feet and raise the level of oceans 30 feet.

On the land there are 500-thousand square miles of lakes, rivers and marshes. These have an average depth of 528 feet. This is equivalent to 50,000 cubic miles of water, which would spread over the land surface to a depth of 55.68 inches. It would increase the height of the oceans by 22.65 inches or would form a layer over the entire earth's surface of 16 inches.

All the water held by plants and

animals would be equivalent to a layer one inch deep over the land surface.

To a depth of 2500 feet below sea level the water held by rocks is 1,084,000 cubic miles. This would cover the land surface to a depth of 100 feet. To a depth of 12,500 feet below sea level the rocks hold 1,285,000 cubic miles, which would cover the land surface with a layer 125 feet deep.

WATER IN CIRCULATION

To a depth of 10 miles below 12,500 feet below sea level the water held by the heated rocks would amount to 19,700,000 cubic miles.

The ingenious mathematical brain of Sir Cyril Fox has gone further and has given some interesting figures regarding the amount of water in circulation, beginning from evaporation from oceans and seas, its precipitation as rain and snow, and its run-off from the land.

For an ocean area of 90-million square miles (of the total of 140-million) the annual evaporation is about 42,600 cubic miles. From ice and snow fields the evaporation reaches the surprising figure of 3030 cubic miles from an area of 8-million square miles. From lakes and rivers 570 cubic miles of water evaporates yearly. On a tonnage basis the total evaporation from these sources reaches the staggering total of 189,000,000,000,000 tons.

On the land surface at an average rainfall of 36 inches per annum 20,000 cubic miles falls annually, while the snowfalls amount to 4500 cubic feet only.

A total of 24,500 cubic miles of water runs off the land annually to replenish the lakes and seas.

The greatest flood ever to occur on earth was that in the time of Noah, mentioned in the Bible. This story comes in for quite an analysis by Sir Cyril Fox.

It is related that it rained at that time for 40 days and 40 nights and that the water covered the earth and that Noah's Ark came to rest on Mt. Ararat.

BIBLICAL "FLOOD"

Sir Cyril points out that the present distribution of land and sea is 57-million square miles of land surface with an average height of 2500 feet above sea level and 140-million square miles of ocean with an average depth of 12,500 feet.

Now, in order to cover Mt. Ararat, which is 17,000 feet above sea level, the level of the sea would have to be raised by that distance and the amount of water added to the ocean would need to be 1.33 times the volume already there. Calculating on a basis of evaporation of sea water to produce a certain amount of rainfall the problem resolves itself into one of not only where the rain came from but where the water ran to after the rain stopped. For the time of 40 days and 40 nights there would need to be a rainfall of 16,250 feet or 200 inches an hour.

Some students assume that there has been some error in the translation of the Bible and that the word Ararat really means the drainage area of the River Euphrates and not the mountain called Ararat, for in the Hebrew language the word Ararat means "sacred land".

However, as the argument turns out, it only goes to show that you can always find someone to throw a spanner into the works.

Having digressed somewhat into the realms of theology we will proceed with my sermon as originally planned.

When rain falls onto the ground it begins to do work and continues to work until it has finally run into the ocean. It is, of course, not pure water but has dissolved in it various impurities from the atmosphere such as carbon dioxide and certain acids.

WATER AT WORK

These acids in the water dissolve various substances from the soil and decomposes rocks and other strata.

Sir John Murray was another computer who calculated that the water which runs off the land annually and flows to the sea carries with it 2,735,000,000 tons of dissolved solids. This is a tidy amount and shows the tremendous effect of rain on the land surface.

Changes in the world's climate over many centuries has been greatly influenced by water. Very often this has been effected by geogrophical change caused by water erosion of the land surfaces, thus bringing about alterations in the drainage system.

At depths of 10 or 12 miles below the earth's surface the rocks are subjected to such temperatures and pressures as to be in a semi-solid condition.

When the pressure is released or when water finds its way into the depths these rocks become molten. Thus the crust of the earth above is subject to great strains and bends under the weight of earth and solid rocks.

If this burden is withdrawn the surface of the earth rises and it naturally follows that the natural drainage of the surface is altered.

THE GREAT LAKES

This has happened in the area of the Great Lakes in North America. During the early Ice Age the earth was covered with a tremendous burden of solid ice. As this melted away its great weight was withdrawn and the crust of the earth began to rise, and appears to be still doing so. It has been established that at one time the lakes drained into the River Ottawa but now are drained by the St. Lawrence. It seems certain that if the land continues to rise the River Mississippi will drain Lake Superior and the Illinois and the Ohio rivers will drain lakes Michigan and Erie in that order.

Erosion of the land surfaces thus has a twofold effect. It causes the away and, conversely, causes sinkage at places where the erosion settles, such as in valleys and deltas. This the extra weight of overburden.

It follows that the effects of water on climate can be great indeed, for

MARVEL OF NATURAL SCULPTURE

The Grand Canyon is probably the world's most dramatic example of water erosion. Here the Colorado River and tributaries have carved enormous chasms up to one mile deep through two billion years of geological history.

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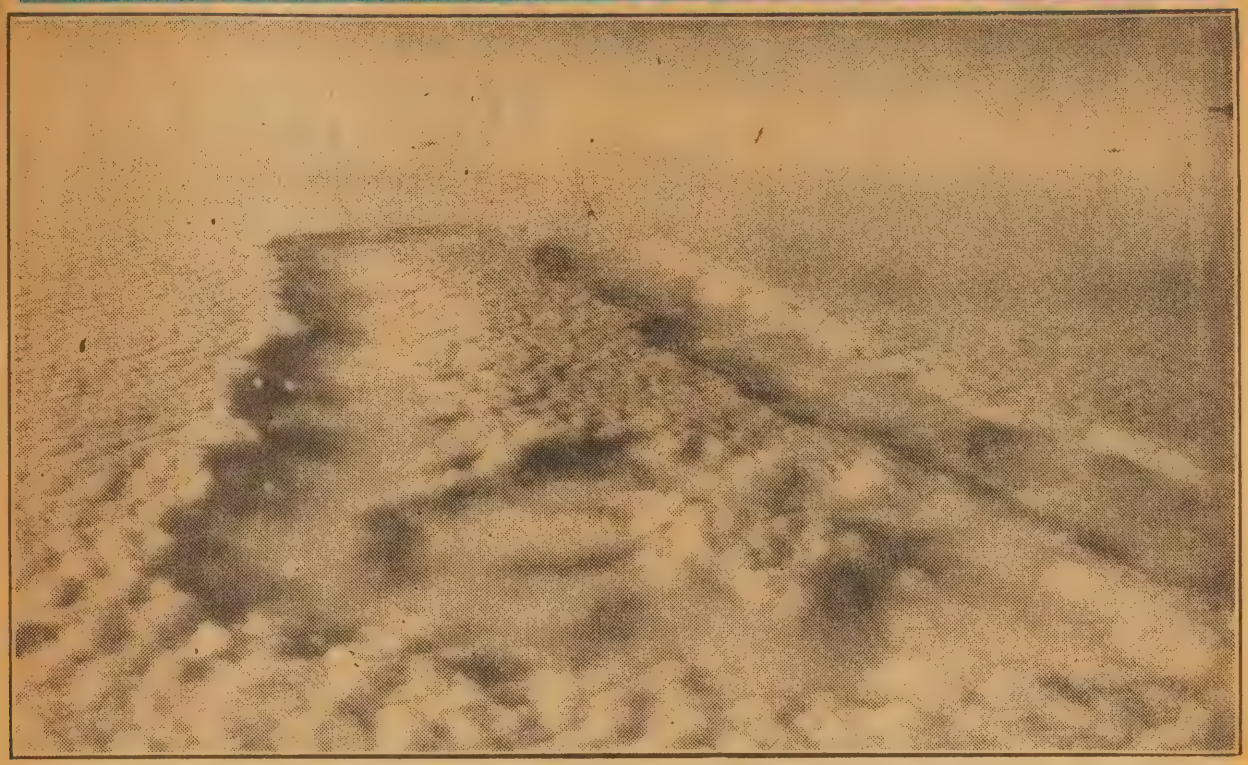
MAN FIGHTS THE ELEMENTS IN SEARCH FOR RAIN



This amazing picture shows a section of stratus cloud seeded with dry ice. This has changed super cooled water droplets into snow or ice crystals which in turn fall out or evaporate. This photo. was taken in USA during rain making experiment. The long sides of the "race track" run for 20 miles.

it is well known that if the drainage systems are altered there can be deserts where once there was fertile land, and vice versa.

One great source of available water is the artesian system which is found in various parts of the world. There is a great artesian system in many parts of Australia which provides bountiful supplies of water to farms and stations.

The word artesian is derived from from the name of the old province of Artois in France. Here water-bearing strata lies beneath an impervious strata. The intake for the water-bearing strata is higher than the water-bearing rock, so that this water is under pressure. When it is tapped by a well or bore the pressure is sufficient to force the water up to the surface.

ARTESIAN BORES

The great artesian basin of south-west Queensland is a notable example of this type of water supply. In this area there is a porous strata covered by a non-porous strata and the water from rainfall comes down from the plateaus and mountains of eastern Queensland. This seeps into the porous layer and percolates for a distance of 400-odd miles to the south-west.

The deepest artesian well is about 7000 feet deep. Most of the water is under pressure from the "head" given to it by the waters higher up and by the pressure of the overlying impervious strata.

Some idea of the great storage capacity of these artesian basins may be gained from the knowledge that as far back as the year 1904 it was estimated that 400-million gallons of water a day were being drawn from more than 1000 wells from depths up to 2000 feet. At some places the water was tapped from wells more than 700 feet below sea level. These are under such pressure that the water is forced to this great height and flows at the top at 300,000 gallons per day.

ARTESIAN POWER

At a place with the resounding name of Thargomindah, in south-west Queensland, one artesian well was under such great pressure that it drove a turbine, which in turn motivated an electric lighting set.

Many artesian wells and springs contain large quantities of minerals. Some springs are hot and when combined with minerals they have some reputation of being curative of certain diseases, notably forms of rheumatism and arthritis.

Water has a very powerful impelling power and can shift vast quantities of heavy sand and earth. This is evidenced in the caves which abound in various parts of the world, such as Jenolan in New South Wales.

The power of water to transport materials is shown by the fact that fine grains of sand .01 inches in diameter can be easily carried by a current of water travelling at a speed of nine inches per second, while it would take a wind of 12 miles per hour to do the same thing.

Water flowing at a speed of 1¾ miles per hour will carry gravel one inch in diameter, but the same material would hardly be moved by a wind of 100 miles per hour.

It thus becomes easy to realise why water is so powerful an agent in causing soil erosion.

The most notable example of this is the Grand Canyon of the Colorado River, in Arizona. This vast canyon was cut by the river, which at one time flowed on the top of the canyon, which at some places is more than a mile above the present course of the river.

The canyon varies in width from four to 18 miles for a distance of 280 miles. During the centuries the river has eroded and carried away some 700 cubic miles of rocks and exposed the sides of the canyon to the further effects of rain, wind, frost and landslides.

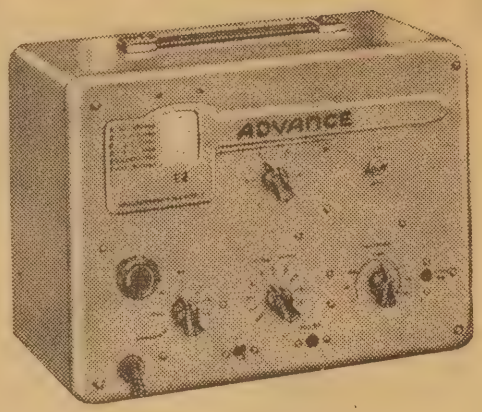
GRAND CANYON

The sides of the canyon show the various layers or strata which geologists use in estimating geological time, and from these it has been estimated that this canyon has been cut by the river within the last million years. Even using this great length of time as a basis, it means that about 7,500,000 tons of rock and soil has been removed every year.

Space does not permit of further discussion of this interesting subject, but enough has been said to indicate to the reader the vast influence which water has on our daily lives.

As a last mathematical shot, it has been estimated that the amount of water consumed annually for the whole world population of 2000-million people for drinking, washing and domestic purposes only is 12 cubic miles, or approximately 50,000-million tons.

Advance SIGNAL GENERATORS



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Accuracy: Frequency calibration plus minus 1% or plus minus 1 c/s

Output: Sine wave—200 uV to 20 volts plus minus 1 db
Square wave—400 uV to 40 volts

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Distortion: Less than 1% at 1,000 c/s

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Technical Review

ELECTRONICS BECOMING VITAL IN MEDICAL FIELD

Research problems confronting members of the medical profession are causing them to rely more heavily on the special resources of the electronics engineers. The truth of this observation was made quite apparent in a recent apparatus show at Manchester (England), reported in the September, 1953 issue of Wireless World.

ALTHOUGH electronic techniques are used in both diagnostic and therapeutic work, there is perhaps more scope in the diagnostic field because of the wide range of phenomena in the body that can be detected or measured.

The most common instruments are probably the electro-cardiograph for amplifying and recording the heart potentials, the electro-encephalograph, for brain potentials and the electro-myograph for muscle potentials.

After this, the apparatus becomes more specialised.

The auscultoscope, for example, is an amplifying stethoscope for examining heart and lung sounds.

The phonoelectrocardioscope amplifies heart sounds at the same time as recording the heart potentials, while the cardiotachometer measures the heart rate in beats per minute.

Other instruments measure the rate of flow of blood and the amount of oxygen in it, and one called the sphygmograph registers the pulse waves in the veins and arteries.

RF HEATERS

On the therapeutic side, the diathermy apparatus or rf heater, is probably the best-known type of instrument. Nowadays it is quite often used by surgeons for making incisions and cauterising wounds.

Then there are stimulators. Most of these are devices for applying electrical waveforms directly to the body, but some generate flashes of light for visual stimulation and others wound pulses for aural stimulation. One stimulator made by Lorenz in Germany is used for giving artificial respiration by applying electrical impulses to the stomach muscles to produce a rhythmic contraction of the stomach wall.

A new type of treatment which seems to be developing very rapidly is ultrasonic therapy.

At one time radio-active substances were only used for therapeutic purposes, but they are now coming into the diagnostic field and bringing with them various electronic devices for detecting and measuring the radio-activity.

In diagnosing cancer of the thyroid gland, for example, a dose of radio-active iodine is given to the patient; the iodine is selectively absorbed by the thyroid tissue and any cancer, and the resulting concentration of radio-activity gives an indication of whether a cancer is there or not and how big it is.

SCINTILLATION COUNTER

Ionisation chambers and Geiger-Muller tubes are often used for detecting the radio-activity, but a much more sensitive instrument now coming into use is the scintillation counter.

In this the radio-active particles impinge on a phosphor and produce flashes of light, which are detected by a photo-multiplier tube. The output of pulses from the tube is then fed into an electronic counter, which indicates the strength of the radio-activity.

Unfortunately, the photo-multiplier tube introduces a certain amount of noise, which could lead to errors in the pulse counting. A way of overcoming this is to have two photo-multipliers "looking" at the phosphor and arrange their electronic circuitry so that only co-incident pulses are counted.

An extremely interesting apparatus, built by the University of London Institute of Cancer Research, displays an image of the distribution of radio-active material in a patient's body on the screen of a cathode-ray tube.

The patient is scanned mechanically by the scintillation counter, which moves backwards and forwards across him on a kind of large pantograph. Pulses from the counter are fed to an electrostatic storage tube and arranged to modulate its "writing" beam, which scans the target of the tube in synchronism with the mechanical scanning of the patient.

COMPLETE PATTERN

In this way a charge pattern is slowly built up on the target of the tube corresponding to the distribution of radio-active material in the patient's body. When a complete charge pattern has been formed, the "reading" beam scans the target at something like normal television speed, and the output signal is fed to the crt display to produce a corresponding visual pattern on the screen.

The image formed in the storage tube can be "read" and displayed for about an hour before it fades away.

One of the great advantages of the television type of display is that the contrast of the image can be altered electronically as required—a feature which was also to be seen in the flying-spot microscope shown by Cinema-Television.

A characteristic feature of the biological amplifiers is that they usually have a differential input stage, consisting of a pair of valves with a common cathode load. The object is to make any interference picked up from the patient cancel at the anodes. To make the circuit give a high rejection ratio, however, the two valves have to be carefully matched and this is not always easy to do.

WORLD'S SMALLEST RADIO

SAID to be the world's smallest, a new standard portable was introduced recently by Emerson. It is known as the Pocket Radio, is 6 inches long, 3½ inches high, and 1¼ inches deep and weighs less than a pound. Smaller radios have been made, but they have been special jobs, with earphones and trick outside antennas.

The Pocket Radio is a standard portable in every respect as judged by equipment, volume and wiring methods. It is variable-capacitor tuned, has an almost flat 2½-inch speaker and standard wiring. The ferriloop antenna, now practically universal on small portables, is a flat bar inside the base of the handle. Circuit is superhet; four subminiature tubes.

The method of removing the chassis is especially ingenious. It is held against the back of the cabinet by little tabs which are part of the chassis frame, and which slip under loops moulded in the plastic cabinet. It is necessary only to slip the chassis an eigth of an inch to the side and lift it right out.

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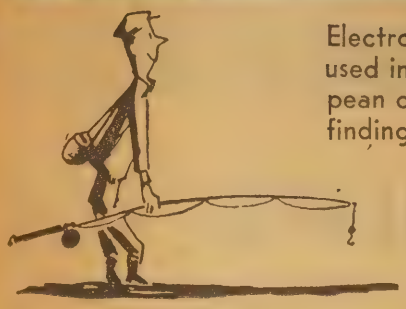


Electronic methods of fishing are being increasingly and successfully used in the waters around Great Britain and some other northwest European countries. The skippers of fishing vessels that carry electronic fish-finding equipment no longer have to search blindly for their quarry.

THE up-to-date skipper sees schools of fish on the screen of a cathode-ray tube and he is even able to tell with fair certainty what kind of fish they are.

It started during World War II, when thousands of British fishermen served in the Royal Navy. A great number of vessels were used for mine-sweeping and rescue work and were fitted with echo-sounding apparatus.

In the early days of the war, echo-sounder operators often gave false alarms, for the returning echoes would sometimes suddenly indicate a depth, not of several hundred fathoms below the ship's bottom, but of something far less.

When recording echo-sounders were installed it became clear that, besides the true echo from the sea-bed, there was frequently a secondary echo from some intermediate source below the surface.

A few of the men who were fishermen in civil life realised that these secondary echoes could be nothing but schools of fish.

Back in their old jobs, they bought surplus echo-sounding gear of the recording type and installed it in their own fishing vessels.

DIFFERENT ECHOES

They had already observed that the fish echoes showed big differences. Some were clear-cut, some rather fuzzy; some had ragged top or bottom edges; some showed a striped effect; some came from near the surface, some from mid-water, some from near the bottom.

From their knowledge and experience of the habits of fish they figured out the species that each kind of echo indicated.

The ex-naval equipment wasn't ideal for the job and they weren't always right in the beginning. But they found fish more quickly than others could and they made bigger hauls. Electronic fish-finding had proved itself.

Then the Marconi Company brought out its Seagraph, a compact and moderately priced echo-sounding recorder, specially developed for small fishing craft. This met with remarkable success.

A great deal of research and experimental work was also done on the Continent, and a German firm — Electroacustic G.m.b.H. — developed the Fischlupe, one of the most successful fish-locators yet devised.

The instrument works broadly on echo-sounder lines — but with a difference. The supersonic echoes are applied as voltage waveforms to a cathode-ray tube.

In the SURVEY position of the large dial the screen of the tube shows a small-scale cross-section of the water from sea-bed to surface. The screen is calibrated for a maximum depth of 300 fathoms (1800ft).

A shoal of fish appears as a bright blob, and the depth at which the school is swimming can be read off from the scale on the screen.

A turn of a knob gives a large-scale picture of a 45ft layer of water at any depth desired. A Y-SHIFT (vertical positioning) knob allows the shoal blob to be centred on the screen.

CLEARER PICTURE

Adjustment of the FOCUS knob changes the picture from a blob to a large number of individual points, each representing the echo from one fish. From the depth, the size of the luminous points, their arrangement, and their movements, experienced fishermen can tell with almost absolute certainty what kind of fish they are.

All echo-sounding instruments operate by measuring the time required for an ultrasonic pulse to travel from the hull of the vessel to the bottom and back again.

Since sonic waves — and ultrasonic waves, of course — travel at a speed of approximately 4800ft per second in salt water, the total distance travelled by the pulse is directly proportional to the elapsed time.

Ultrasonic frequencies are used not only because their short wavelengths allow the transmitting and receiving heads to have small dimensions and high directivity but also because they can draw a more accurate picture of the bottom than longer waves.

As an example, the US-built Bendix model D1-1 depth indicator starts with a 50-kc oscillator which is turned on and off 240 times per minute by a motor-driven keyer.

It is on for only a few thousandths of a second each time, so that the effective interval between successive pulses is approximately a quarter of a second, or long enough to allow each pulse to travel a total distance of 1200 feet.

Since the pulse has to travel to the bottom and back in this time, the maximum depth it can indicate is 600 feet (100 fathoms).

This model uses the same transducer head—a magnetrostriction unit mounted in a waterproof housing on the outside of the hull—for transmitting and receiving, but some types of equipment have separate heads for each purpose.

CATCHING FISH

Apart from the purely electronic methods of fish location, much progress has been made in actually catching fish by electrical methods.

These are now in use in many inland waters in Britain, and much experimental work is going ahead both here and in other European countries with a view to applying them to sea fishing.

Briefly, the principle is this: When an electric field is set up in water around them, fish of all kinds are irresistibly repelled from the cathode, or negative pole, and attracted toward the anode. In a weak field of only a few volts the fish merely align themselves head-to-anode along the lines of force.

Raise the voltage somewhat and they move toward the positive pole. Make it still higher and they are stunned—though only temporarily.

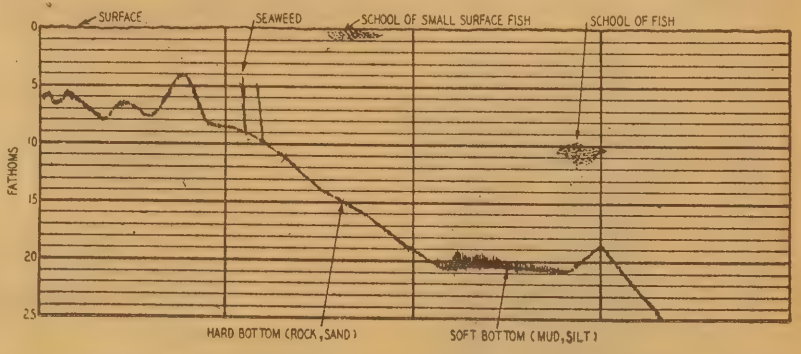
This method is regularly employed nowadays in many British trout streams for ridding the waters of cannibal fish and other undesirables.

The negative pole of a gas-driven generator is connected by cable to a metal plate set upright in the water. A second cable connects the positive pole to the wire meshes of a kind of landing net operated by a man in a boat.

Fish swim toward the net and the unwanted specimens are easily eliminated.

In some streams a more intense electric field is used for short spells. All fish then come to the surface in a stunned condition. The undesirable sort are picked out.

(Radio-Electronics, Sept., 1953.)



A composite chart showing typical indications reproduced by various underwater conditions on a Bendix model DR-10 depth recorder.

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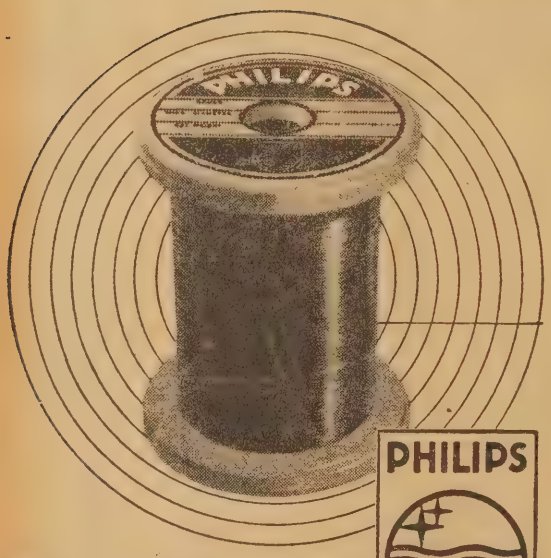

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DISPOSING RADIOACTIVE WASTE IS COSTLY PROBLEM

Though scientists have solved many problems to do with radioactivity, they have not yet worked out what to do with the radio-activity waste from research and production centres. The problem is summed up in a recent article in "Nucleonics".

THE current solution to the problem of disposing of large quantities of radio-active waste is to evaporate the dilute waste solutions to saturation and then to store the resulting liquid concentrate in underground steel tanks. Such a storage is expensive, however.

Cost is increased still more when cooling coils are required in the storage tanks to remove heat generated by radio-active decay in large quantities of high-level waste during storage.

In addition, such storage is not permanent. Corrosion makes eventual replacement of the tanks necessary. Some hazard exists, too, for leakage could readily contaminate ground water and surroundings.

THE REQUIREMENT

These factors indicate the desirability of developing a storage method that will be relatively inexpensive, permanent and radiologically safe.

Various proposals for concentration and storage have been made; most of them involve solidification of wastes and storage of the resultant solids.

The purpose of the study reported here was to make an economic comparison of the proposed methods and to estimate the economic feasibility of those methods showing industrial promise.

To obtain a workable basis for economic comparison, processes were evaluated and costs estimated for a plant at Oak Ridge, Tenn., with an assumed production rate of raw waste of 2000 gal/day at an activity of 20 curie/liter.

PRECAUTIONS

Certain initial assumptions were made:

(1) Any effluent stream from the process under consideration that is not sufficiently low in activity to be safely discharged to the surroundings must be stored or decontaminated.

(2) Any permanent storage facility must be efficiently shielded to protect personnel from direct radiation. In the case of underground storage, there must be no chance of leaching of radio-active materials by ground water, nor should there be any possibility of concentration of radio-active materials by plant or animal life.

(3) Generation of heat by radio-active decay should be low enough in permanently stored material that radio-active components do not volatise.

(4) In the case of temporary storage of high-level wastes to reduce activity through decay before permanent disposal, it has been assumed that the optimum temporary storage is about five years. Activity decays to less than 2 pc of the initial value in this period (2), but the decrease in activity with time thereafter is insufficient to justify the cost of storage.

Pumping of high-level radio-active wastes into exhausted or "dry" oil wells has been proposed. Such wells existing from 1000ft to 10,000ft below the surface of the ground, would be gastight, and migration of the waste solution through the rock strata would be slow enough that no danger of radio-active contamination would be present.

This disposal method offers the advantage that the wastes need not be processed but may be disposed of directly. The major requirement is that dry wells be available within a reasonable distance of the waste source.

The major portion of the cost is incurred in transportation of the wastes. For example, a truck carrying 150 gallons of waste would require 10 tons of lead shielding.

Fusion of wastes into a glass that could be buried at a local site has been suggested. This process would involve evaporation of the liquid wastes to dryness, fusion of these solids with an inexpensive glass, and manipulation of the product into a form suitable for burial. It would be necessary to recover radio-active materials that volatise during fusion.

The main advantges of this method are that the resulting glass should not be subject to leaching, and that it should be possible to permit fairly high temperatures in the final buried product.

No fusions of dry radio-active material in glass have been made to date, and in view of cost estimated here it is questionable whether an experimental program is justified.

Incorporation of concentrated liquid wastes into a concrete monolith that can be buried for permanent disposal has been proposed. The principal difficulty is leaching after burial.

Experiments with radio-active materials incorporated in Portland cement concrete indicate that about 5 pc of the radio-activity is leached out fairly rapidly, but that thereafter substantially no more radio-activity is removed.

Based on the studies to date, three proposals have been made for safe, permanent disposal: sea or land burial of unleached concrete, or land burial of leached concrete.

LOW RAINFALL

If concrete is to be buried on land without preleaching, the burial site must have a sufficiently low rainfall to preclude the possibility of ground-water contamination.

One authority has suggested making a non-radio-active concrete "projectile" with a tank fastened on the rear to contain concentrated liquid waste (2). This projectile was to be dumped 500 miles off the coast of Georgia, where the ocean is 15,000ft deep with a muck bottom of 100-200 ft and stagnant water above the bottom.

The projectile was designed to reach a high velocity during descent so that it would bury itself deeply in the muck, eliminating radiological hazard.

RADIO FOR SHIPWRECKED CREWS

(Continued from Page 13)

rod which can be stowed inside the front cover of the unit. Although this rod is collapsible for stowage purposes, it is not telescopic. This rod is made up of eleven captivated sections, fastened to one another by internal flexible cables.

Each section has a built-in socket which fits into its adjoining mate. The assembled height is 15 feet. Such a rod may be put together quickly without losing any of the parts.

The lower end of the rod plugs into a special insulated socket at the top of the lifeboat set. A 15-foot vertical antenna should be stayed in some manner to prevent excessive whipping in high winds, and also to increase its radiation efficiency. This is done by four pieces of flexible wire, each eight feet long, connected near the top of the rod and then stayed off through insulators and ropes to the sides of the lifeboat.

There are two other optional antenna arrangements for the types of lifeboats which have masts. A flexible wire can be rigged between the top of the aluminium rod and the mast. If the rod is lost or damaged, a single wire antenna can be run from the top of the set to the mast. Extra wire and insulators are stowed in the cover for these arrangements.

The material from which the insulators are made is a plastic with the formidable name of Tetrafluoroethylene. Its short name is Teflon, a Du Pont trademark. This plastic is light, flexible and has extremely low moisture absorption and radio frequency losses.

CONSTRUCTION

A final word about the physical aspects of the equipment. The aluminium cabinet is reinforced internally to withstand the drop test. The front cover, held in place with spring latches has a watertight gasket. All front panel devices, since they are exposed to the weather during operation, have rubber seals.

The sockets for the generator cranks appear to be open, but just inside they are sealed with a flexible metal bellows coupling. The set is painted with a color known as Munsell 7.5 Red, which some have called "shocking pink".

Radiomarine has developed and manufactured several types of lifeboat sets since 1936. This new equipment meets all requirements of the Safety of Life at Sea Convention as well as Rules and Regulations of the Federal Communications Commission for lifeboat portable radio sets.

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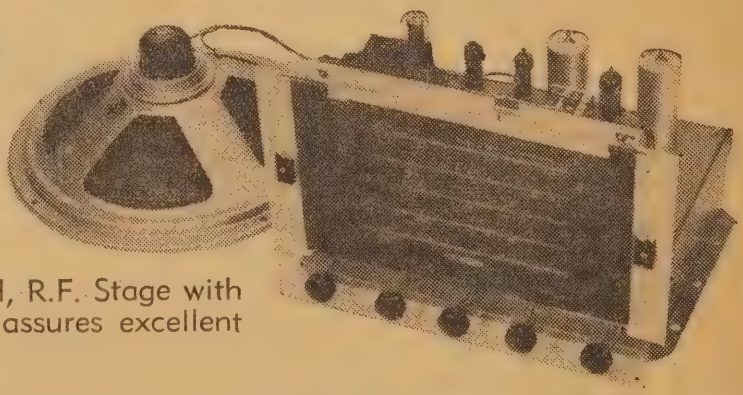

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NEWS AND VIEWS OF THE MONTH

Radar plots currents

RADAR is to be used to trace Bass Strait currents off Cape Schanck. This will help plot a suitable place for a Melbourne sewer outlet.

A survey team will spend some weeks in the area, operating from a mobile unit.

Forty-four gallon drums, with radar reflectors, will be dropped into the sea.

Their course, as they are moved by currents, will be traced on to a radar screen on the cliffs.

The survey will show the best place for the outfall, where sewage will be quickly carried out by currents.

Do bees talk?

NOT only do they talk, says Dr. Karl von Frisch, of Munich, but they have their own dialcets. Dr. von Frisch is an authority on the physiology and behavior of bees. He has established that they have a language and can virtually talk to each other.

The language consists mainly of signs similar to those used by deaf and dumb people. In addition, bees make use of odors of types to which insects are extremely sensitive.

Dr. von Frisch has reached the point where he can gain some idea of what the bees are talking about and predict their behavior.

Finding uranium by air

IN America, they are hunting uranium deposits by air. Prospecting on foot is a long and tedious business. Aircraft using new equipment are faster and in the long run more economical, and are employed by both private concerns and the Atomic Energy Commission.

The basis technique is for a low-flying plane carrying a scintillation detector — super-sensitive successor to the Geiger counter—to fly over measured strips of a given area. Any reaction by the detector is marked on a paper tape, which is synchronised with a 35-mm camera mounted on the plane's tail that simultaneously maps the area surveyed.

Interior and AEC air-prospectors work in teams, with the Interior men covering an area first. They have thus far used one instrument-equipped DC-3 in which they fly at about 500ft mapping up to 600 square miles a day. Another DC-3 is being similarly equipped. The AEC crews fly considerably lower in little Piper Cubs in an effort to get more detailed readings.

Prospectors are warned that the maps show only the presence of radioactive deposits, some of which may be so diffuse as to be unworkable. But the potential profits from a good deposit give pretty fair assurance that some one will report on every area to the uranium-hungry AEC.

More flying saucers

ONCE again, flying saucers are in the news. Teams in both Britain and the USA are reported to be making systematic attempts to track them down, as they continue to make an appearance from time to time.

Apparently most of the alleged saucers have been explained away by reasonable theores of meteorological conditions and optical illusions. Early in their history, these theories were held to account for all such phenomena.

Lately, however, it has been admitted that a percentage of saucer sightings are so well authenticated as to defy such explanations. About 5 pc of them bear the stamp of truth, and it is this percentage which is worrying the authorities.

For instance saucers were reported over the area in which American flyers recently lifted the world's flying speed record, with the same characteristics of luminosity and high speed consistent with most of previous reports. Over England, similar happenings are vouched for by reliable observers both in the air and on the ground.

Where do they come from? Nothing new has been suggested. Mention is still made of visitations from other planets, although most credable observers both in the air and perimental aircraft in the super secret group. Latest information on incredible flying achievements and remote control makes this highly probable. Official interest and action could even be part of the secrecy plan.

One thing is certain. The first positive identification of a saucer will make headlines in every newspaper in the world. So far our mysterious visitors have enjoyed a suspiciously succesful life of anonymity. Until the secret is out, we can only continue to hope that they are "ours" and not "theirs", whoever "they" might be.

Headaches for thinkers

THOUGH thinkers are more likely to suffer recurring headaches than manual workers, the ache does not arise from wear and tear, pain or surprise caused by the process of thinking.

This was stated at a meeting of

POPULAR SCIENCE QUIZ

Q.: What is "hydrazine"?

A.: Hydrazine is a compound of hydrogen and nitrogen. It is closely related to ammonia except that it has a different proportion of nitrogen. It is a liquid which resembles water and, in fact, its density, melting point, and boiling point differs very little from that of water.

It was discovered in 1887 by a German chemist named Curtius and was used in many laboratories as a reagent. During the World War II the Germans found that a mixture of hydrazine, wood alcohol and water made a very high power explosive which was relatively easy to handle and control. It was used in German rockets and in the Messerschmitt 163B fighter plane toward the close of the war.

A hydrazine derivative called TB-1 has been used in the treatment of tuberculosis. It reinforces the action of streptomycin against the tubercle bacillus. Other hydrazine derivatives are potent antiseptics, while a few have antibiotic properties. Several other derivatives are under development as insecticides, some for use in detergents and in making cheap bone glue as tough and durable as expensive plastic adhesives. A number of hydrazine chemicals are added to diesel fuel to improve ignition and several are used in color photography as dye sensitisers and fog preventives.

Q.: What is blood plasma?

A.: Plasma is the liquid portion of blood which remains after the red and white corpuscles are removed. While whole blood is essential in the treatment of some injuries, blood plasma only may be used in thousands of other cases. When a large quantity of plasma is lost due to serious burns or other injuries, the body usually suffers a condition known as "shock". If the loss is serious and the plasma is not replaced, the result is usually death.

There are simple emergency measures which can increase the volume of blood in the body. While inferior to blood transfusion, the drinking of a water solution of salt containing a certain amount of sodium bicarbonate has been used as a satisfactory emergency treatment for shock due to severe burns.

Q: What is the "missing link" in the invertebrate world?

A.: The tiny creature called the peripatus is the "missing link" of the world of animals without backbones. It is neither worm nor insect, although it has characteristics of both. It looks somewhat like a caterpillar and has an internal structure much like the higher worms.

There are some fifty species known to science and it is found in Australia, New Zealand, Africa, Southern Asia, South and Central America, and the West Indies, except Cuba. It stays in damp earth under rotting logs during the day, coming out only at night.

Fossils of the peripatus have been discovered in rocks found inferring that they must have to be half a billion years old been among the first animals to invade dry land.

ROLA Ellipticals

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5.7L	5	F86	115	110-6,000	3.5	7¼" x 5½"	6½"	5½" x 4½"
6.9H	4	F70	115	110-5,500	3.5	9⅞" x 6⅞"	8½"	8½" x 5½"
6.9L	5	F70	115	110-5,500	3.5	9⅞" x 6⅞"	8½"	8½" x 5½"

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AND ALL LEADING WHOLESALERS

the International College of Surgeons.

Headaches arise mainly from what the thinker does.

Dr. Francis L. Lederer, otolaryngologist of the University of Illinois, said, "The thinker reads more, uses his eyes more, and often works with his neck muscles under strain."

The thinker has more time to build up tensions, less chance to work them out by exercise, he said.

The non-thinker was usually "too busy with routine work, had no time for headaches".

Dr. Arnold P. Friedman, director of the headache clinic of the Montefiore Hospital, said "thinkers take in more wavelengths" from events and thought around them, have more chances for unconscious anxieties.

Possible causes of headaches included physical health, stress and strain, emotions, the kind of job or marriage a person had.

Commercial TV

IF we can't have both national and commercial television, then let us have only commercial television, because "it's more entertaining and self-supporting".

That is the consensus of Australia-wide opinion, as disclosed by a recent poll.

In this survey, interviewers first reminded each of the 1800 people interviewed that the Government might have to decide between having only national television, with a £5 fee, or only commercial television, with advertising and no fee.

People were then asked: "If you had to choose, which would you prefer—national or commercial television?"

Throughout Australia, opinion is:

52 pc would prefer commercial television, and

35 pc national television, leaving 13 pc undecided.

Reasons for preferring commercial television are:

- More variety, entertaining.
- Reduce costs, self-supporting.
- Competition, private enterprise.

The minority, however, contend that:

- There's too much advertising with commercials.
- Better programs on nationals.

British research

BRITAIN has remained in the forefront of nuclear research, Professor Ernest Titterton said recently.

Professor Titterton, Professor of Nuclear Research at the National University, was lecturing at the Royal Empire Society.

After the war British scientists had to start from scratch with badly-equipped laboratories and few trained students, he said.

But now Britain had enough scientists and equipment for rapid nuclear development.

Professor Titterton said that at present there are five "accelerators" for splitting atoms in Australia.

Three are at Melbourne University and two at the National University.

Tests at Woomera would keep Australia advanced in nuclear research, he said.

Professor Titterton said that, according to an American survey, the world's oil resources would be exhausted within the next 30 years.

"Atomic energy may replace oil, but we must be very cautious," he said.

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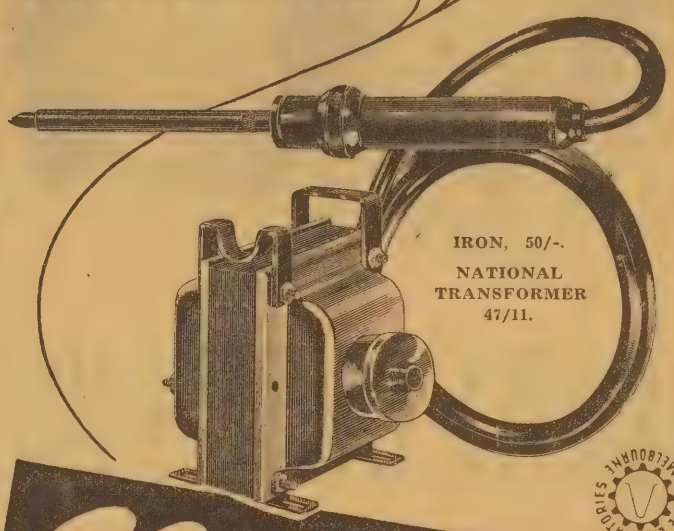

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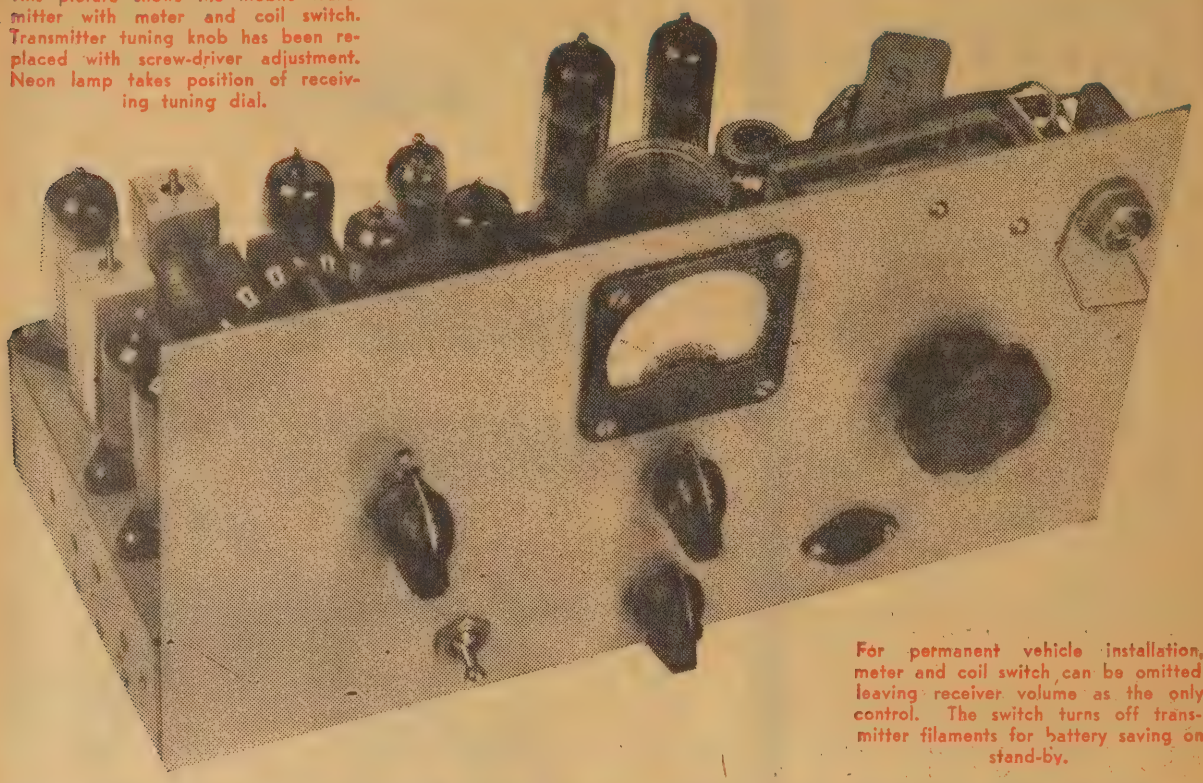
This picture shows the mobile transmitter with meter and coil switch. Transmitter tuning knob has been replaced with screw-driver adjustment. Neon lamp takes position of receiving tuning dial.



For permanent vehicle installation, meter and coil switch can be omitted leaving receiver volume as the only control. The switch turns off transmitter filaments for battery saving on stand-by.

MOBILE BUSH FIRE EQUIPMENT

Last month we described a complete set of transmitting-receiving equipment suitable for bush fire work, small ship communication, &c. In this article we consider the equipment in further detail, with particular reference to mobile operation. Suggestions are also made for its use as a base station.

LAST month's equipment presented a basic design for a receiver and transmitter on a single chassis. The receiver could be tuned by a standard condenser, or crystal locked to operate on two fixed frequencies.

The transmitter was crystal controlled, also on two different frequencies. A simple form of aerial connection allowed it to be used with almost any length of wire or an aerial whip.

AS BASE STATION

By adding two valves and altering the value of three resistors, the transmitter could be doubled in power, thus making it suitable for operation as a base station. Power supplies were described for battery and AC operation, either of which would plug into the main chassis.

Our aim was to include as many features as possible in this initial version, so that builders could easily adapt it to their own use.

The ideas of many experienced people, particularly in connection with bushfire work, vary considerably. For instance most like to use whip aerials on vehicles, although others demand a wire aerial when conditions are tough and when circumstances allow. Some like to consider the gear as a package installation, removing all knots which can be twiddled by inquisitive fingers. Some like to use a tuning meter, while others think it might be damaged and don't want it. These are only a few points of difference which arise.

It is very difficult to be dogmatic on any of them, particularly when the equipment is likely to be operated by unskilled people.

by John Moyle

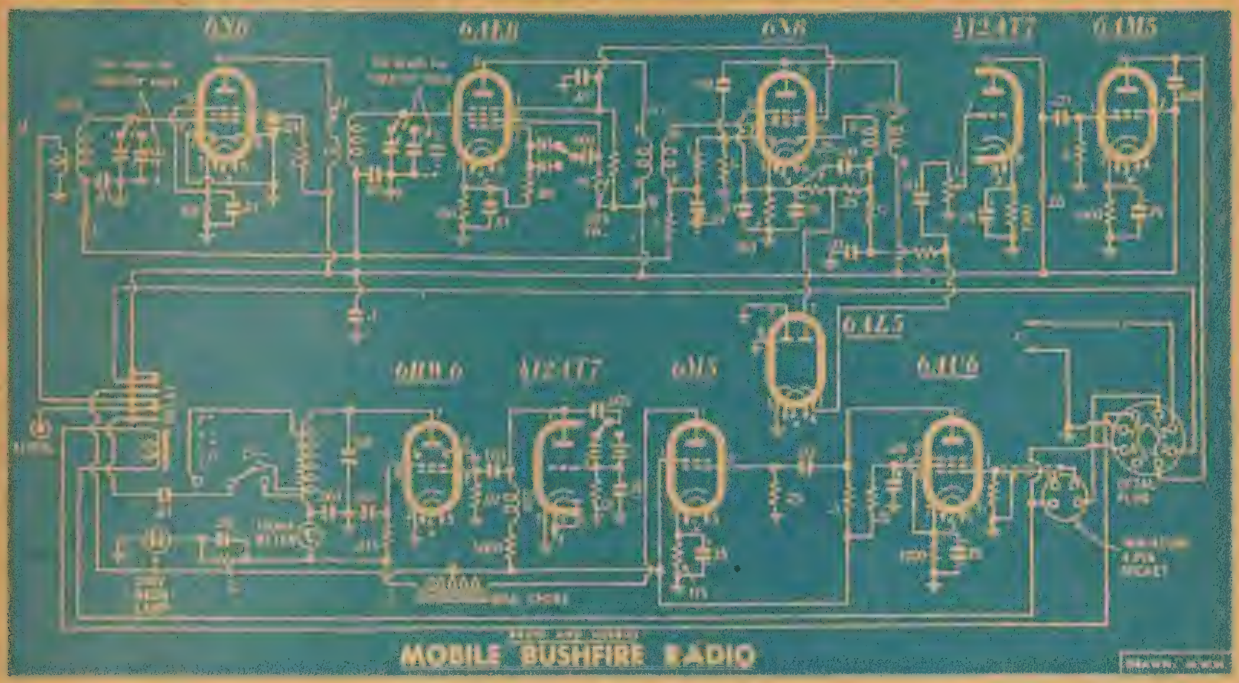
This month, however, we are showing two versions of the gear as representing our own ideas on the matter.

It is probable that experienced radio men will be able to make further improvements, particularly of aerial systems, which will allow the utmost to be obtained from the equipment. Our problem is that we cannot assume too much knowledge on the part of the constructor and we must aim for good results consistent with the greatest simplicity in design and adjustment. We are confident, however, that the gear just as described here will work, and work well. This confidence is borne out by field tests in which it has equalled the performance of any similar equipment we have seen to date.

The only difference between the circuit shown here and that of last month is in the noise limiter hookup.

In an endeavor to keep the receiver standing current as low as possible, we used a germanium rectifier in the original, and it ap-

CIRCUIT DIAGRAM OF THE MOBILE EQUIPMENT



The circuit uses a valve noise limiter diode which is preferred to the germanium crystal shown last month. The wiring of the neon indicator lamp is also included. Two switched crystals are shown as would be used in base station. The 7500 ohms bleed resistor is only used with an AC power supply to prevent receiver voltage from rising too high due to its low drain. Leabe it out for mobile work.

peared to be doing quite well. Unfortunately, the supply of these rectifiers is extremely patchy, and we have, therefore, reverted in this month's circuit to a standard diode using a 6AL5 valve.

As a matter of fact we would recommend this valve in any case, as it is more efficient than the crystal, and experience with the equipment in noisy city areas has shown how important this part of the circuit can be. It might be possible to approximate the operation of the valve by doing some work with circuit values, &c., using the crystal, but we doubt whether it would work out as well.

CRYSTAL LOCKED

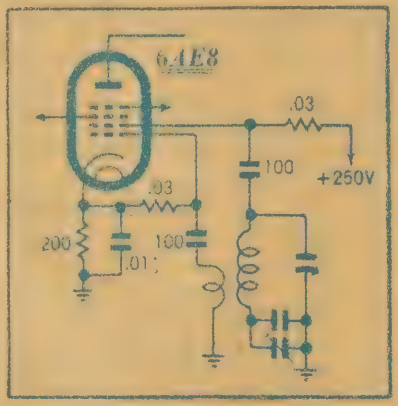
When used mobile, the equipment will normally operate on only one frequency for both transmitting and receiving. There is no need for any tuning control on the receiver, and it is therefore crystal locked. This means that the gang condenser is not fitted, and in its place we have a pair of trimmers paralleled with a suitable fixed condenser if necessary to line up the aerial and RF coils. Once these are adjusted, the receiver needs no more attention. There is no crystal switching to be done either for receiver or transmitter, and this switch is removed. A small shield between the trimmers avoids danger of feedback.

The socket for the 6AL5 is wired near the 12AT7 and the 6AM5 where connections to it are quite short.

Incidentally, as only one noise limiter diode is used, a 9006 which consumes only .15 amps through the filament, could be used. This is a diode made for VHF work, but there were some available from disposals sources. The 6AL5, however, is the standard type available everywhere.

So much for the receiver, which now has only a volume control to twiddle!

The transmitter section remains as shown last month for mobile work, although the following points are made.



Circuit for the receiver converter valve when a tuneable oscillator is used. Suitable coil data is given on page 35.

If the transmitter is to be used with a fixed whip aerial it should be possible to find the best tap on the tank coil, and to make a permanent connection. The tapping switch could then be omitted, thus removing yet another control from the panel.

If there is a possibility of a wire aerial being used, or any aerial other than the original whip, the switch should be retained. Without it, an optimum adjustment for any given aerial won't be possible. Our tests show that a wire aerial of about a quarter wave-length with one and thrown over a tree will always perform better than a whip, and the ability to use such an aerial we think is worth retaining. Sometimes it might mean the difference between useable signal strength and no communication at all. We suggest that every vehicle be equipped with at least two such aerials, complete with a length of cord and a weight for slinging over the tree.

FIXED TUNING

The transmitter tuning condenser can also be adjusted and locked for single aerial operation. The present type of condenser can be retained with the shaft sawn off short and provided with a screwdriver slot adjustment under a panel flap. The shaft can be locked in a number of ways after setting. A small brass bar carrying a set screw and mounted on the rear of the frame so that the screw locks against the spindle end is a good way. Don't attempt to lock by tightening up the back bearing. This will throw out the plate alignment, and the condenser will probably flash across on transmission.

It is not necessary to use such a large condenser, although it is invaluable to bring the tank circuit to resonance if the aerial is changed. A midget type of about 150 pf having reasonable spacing can

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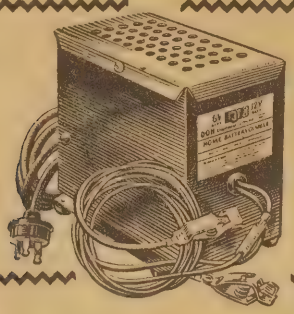

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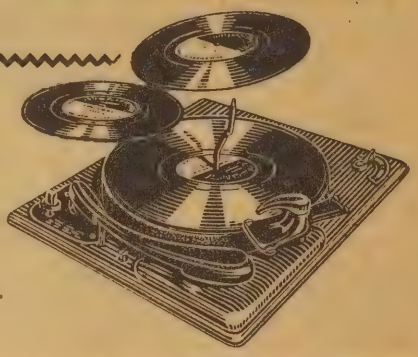

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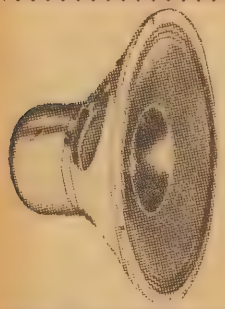

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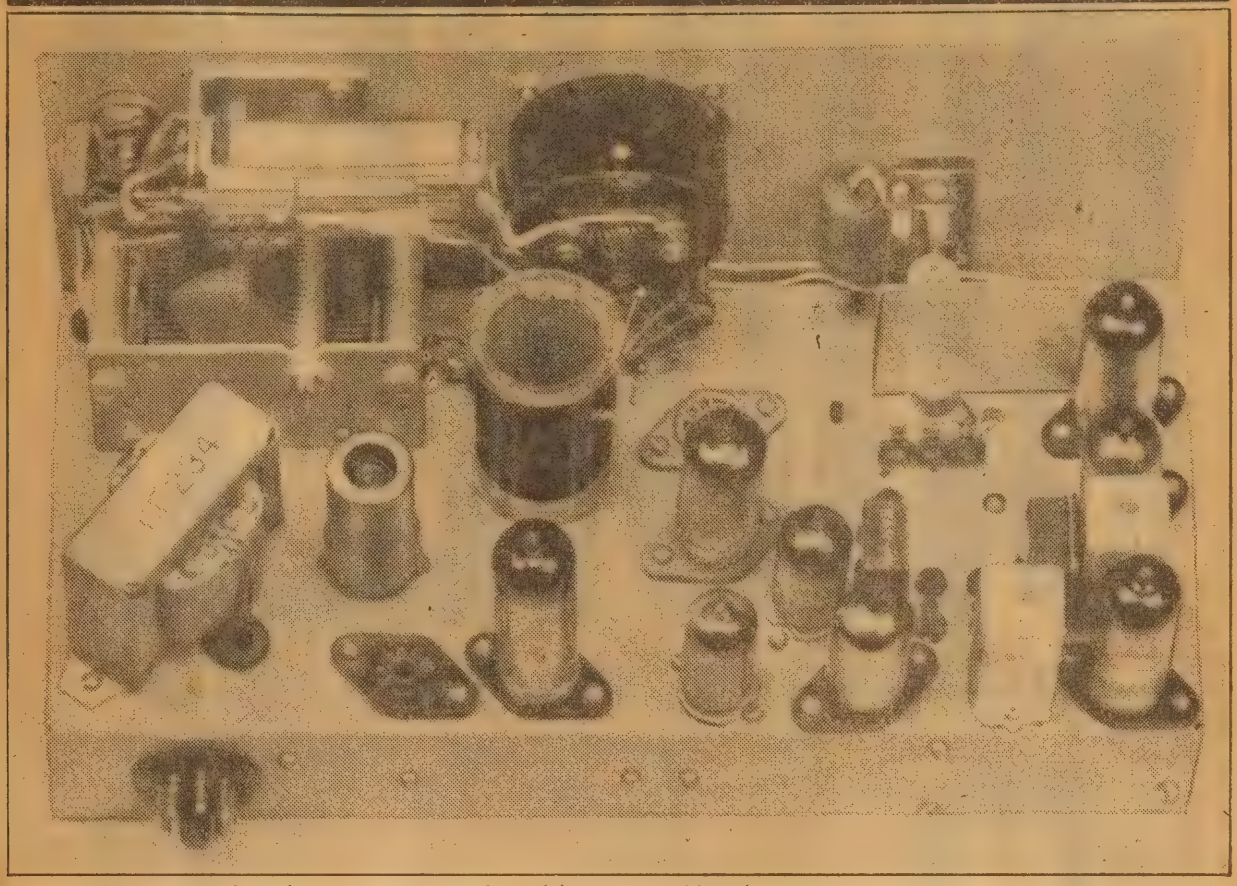
TOP VIEW OF MOBILE TRANSMITTER-RECEIVER



Here is the equipment from the rear as it appears for mobile operation. Note the trimmers separated by a small shield in place of the tuning gang. The vacant sockets are for parallel PA and modulator valves to increase power for base station work. Only two crystals are used for single channel. Both meter and coil switch could be omitted, and a smaller transmitter tuning condenser used with a pre-set adjustment made behind the panel. Controls would then be at minimum. Note noise limiter valve behind the 6AM5 and 12AT7. The neon indicator is panel mounted behind the trimmers.

be used instead, and mounted with a bracket on the chassis without a panel control. This condenser is then adjusted with the transmitter removed from its case, and it will probably hold its setting without any locking device. The tank coil will need to be selected more carefully with the smaller value of capacitance to make sure of hitting the desired frequency with about 100 pf in circuit.

Even the meter can be removed from the panel by providing a socket into which a test meter can be plugged. A meter shunt for 50 mills should be mounted across this socket to provide circuit continuity.

METER CONNECTION

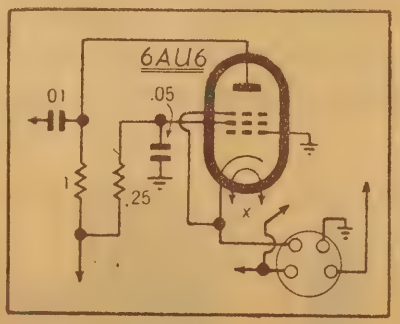
When tuning up the transmitter, the appropriate meter is plugged in and removed after adjustment. The socket could be mounted where the meter is now.

An addition we have made to the circuit is an ordinary neon indicator light of the type widely sold for use with AC mains. This light is connected so that when the transmitter is used it glows rather dimly. On speech it will flash up and down to indicate that the equipment is operating. Many readers have stressed the confidence they obtain from such an indicator which also shows roughly the amount of modulation being used. Practice will tell you how much the lamp should flicker for good speech volume.

If the transmitter is modulated too heavily results will suffer. The transmitter will distort, and the speech will be hard to understand. The neon will help you to avoid this happening by indicating when the voice is too loud.

Another point not entirely resolved by argument is the best type of microphone to use. There is little doubt that the crystal microphone is best for intelligibility. It has that crisp quality which defines each syllable. Its biggest drawback is its sensitivity to heat, and a spell lying in the sun on a hot "bush-fire" day will probably damage it.

The carbon microphone is favored by many because it is almost impossible to damage. The speech quality is definitely inferior, but not as bad as all that. Some claim that it isn't as likely to pick up "noises off" as the crystal, and there is frequently some rather plain speaking within mike range during a fire!



This circuit shows how a carbon microphone can be connected in the cathode circuit of the pre-amplifier valve. Its cathode current energises the button. Grid is earthed.

CRYSTAL OR CARBON

This equipment allows either crystal or carbon microphones to be used. The crystal type is connected from the pre-amplifier grid to ground across a 2 meg grid leak. The carbon mike can be connected either via a transformer into the grid of the modulator, or connected in place of the bias resistor and condenser of the pre-amplifier, the grid of which is then earthed. This latter connection is very simple and convenient, but requires the extra valve as against transformer method.

In either case there should be no need for a gain control. If there is consistently too much volume so that transmisison is distorted, the modulator grid lead can be split, and connection from the coupling condenser made to the junction, thus

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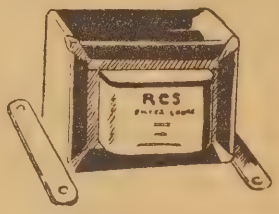

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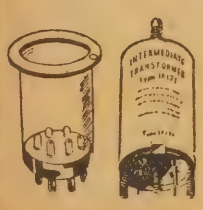

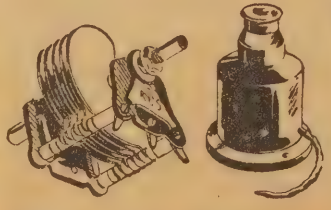

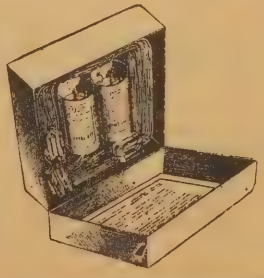

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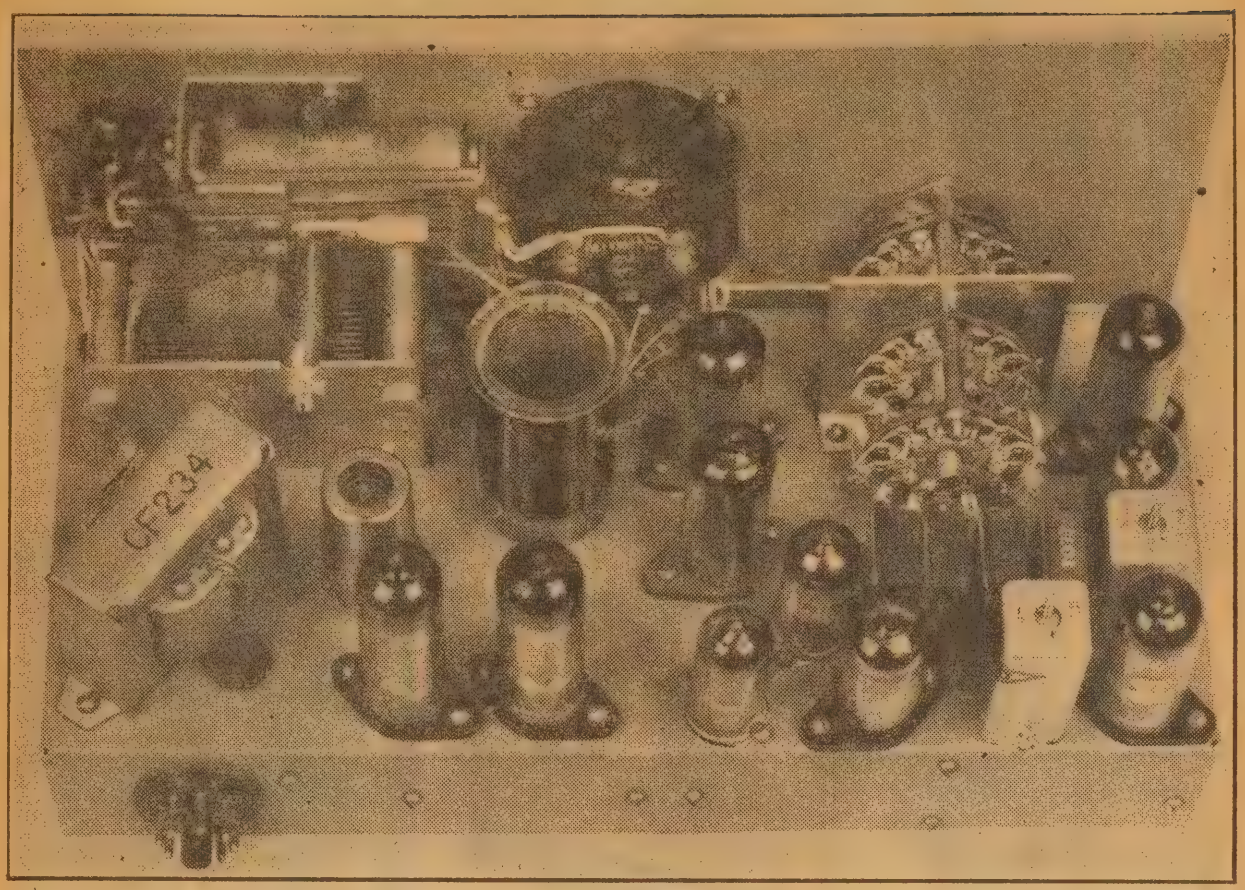

A rear view of the set for base station use. A switch is in receiver gang position controlling the coil trimmers and the four crystals. Both PA and modulator sections use parallel valves for extra power. This connection calls for halving values of PA grid and screen resistor valves, and modulator cathode bias resistor. The 7500 ohm bleed resistor shown in the circuit is included in this version. The large transmitter tuning condenser is retained to cover tuning requirements when frequencies are charged.

forming a "fixed control", if we may use such a term.

Thus you will see that the mobile version may be simplified so that the panel carries no controls other than a switch and receiver volume control. If greater flexibility is needed, the tank coil aerial switch and tank condenser tuning control can be added. Very little difficulty should be experienced in teaching any normal person how to use them.

BASE FREQUENCIES

When the equipment is used for a base station, conditions are somewhat different from those in the field.

First of all, there are two frequencies at least to be accommodated, which means the retention of the crystal switch. Despite the case which some readers make for a tuneable receiver, we still think that both receiver and transmitter should be locked to the operating frequencies. If other listening is desired, a separate receiver should be provided. This one is meant for emergency service, and there should be no risk of missing vital messages because the receiver has drifted slightly, or is off tune.

However, we are including a coil table as a guide for those who wish to tune the set over the range of 2-6 mc.

Two sets of data are given to make sure that you succeed in making the set cover the full range, which is only just tuneable by the condenser. If your highest frequency is 4-5 mc you could probably improve performance a little by using more turns on the coils. Think twice about this, however, as the job of obtaining good tracking is tedious, and occupied Maurie Findlay quite a few hours. The receiver has ample gain, and we doubt whether you will notice any appreciable drop in performance anywhere on the dial.

Our recommended base receiver, therefore, has a switch mounted in place of the gang. The first two wafers accommodate the two sets of trimmers which line the set to each frequency, and the rear wafer changes over both receiver and transmitter crystals. They are physically placed so that short leads will result for all circuits.

COIL TRIMMING

In the receiver, the highest frequency will probably require only the trimmer condenser, if the right number of turns is used. The lower frequency will probably be beyond the adjustment range of the trimmer, in which case a small mica padding condenser will be used to make up the difference.

The transmitter frequency is changed by flipping the coil switch to its pre-determined position, and tuning to resonance with the plate tank condenser. A few seconds should be enough for this. We strongly advise a built-in meter for the base station, as no other method is as good for showing not only when it is tuned to resonance but also when the correct aerial loading is present. The coil switch sets the degree of loading, and the condenser adjusts for resonance or minimum plate current.

The neon modulation indicator can be used with the base station just as effectively as with a mobile, and may be mounted in any convenient position on the panel. In most cases, however, a slight movement of the current meter will take place when modulation is adequate.

COIL DETAILS

The transmitter coil shown in the photographs will tune from above 7 mc to about 3 mc. It has 26 turns of 19 B & S wire on a 1¼ inch former spaced over 1 7-8 inches and tapped at ½, 1, 2, 3, 4, 6, 8, 10, 12, 15 and 18 turns from the bottom.

For frequencies of 4.5 mc and lower, a better coil would be one of 45 turns on the same type former close wound and tapped at 1, 3, 5, 7, 9, 13, 17, 21, 25, 31, and 37 turns from the bottom. If you would like to experiment, you can wind your own coil, using enough turns to tune to frequency with about 100 pf tuning capacitance. But the coils suggested above should present a fairly good compromise. Care should be taken with the base station to make certain the intershire frequency can be tuned as well as the shire frequency itself.

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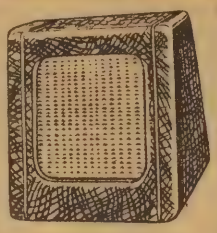

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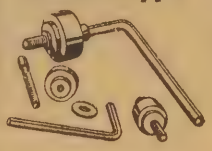

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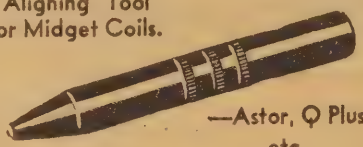

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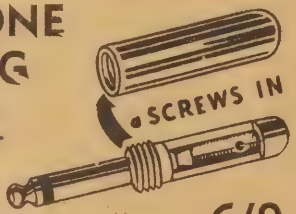

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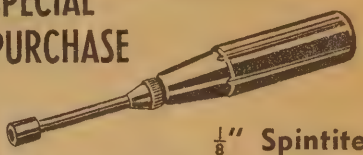

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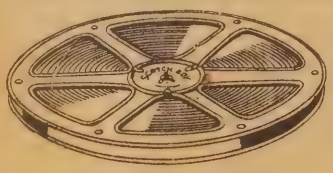

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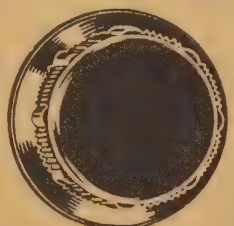

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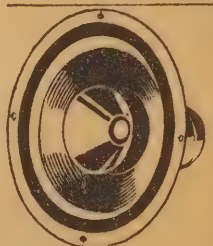

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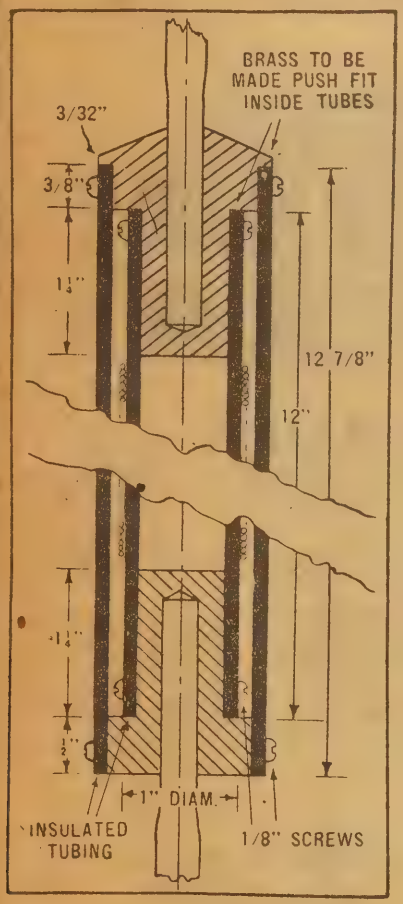
The aerial system with any transmitter is an important matter and involves many electrical and physical considerations. As with so many matters of engineering, we must be prepared to arrange some compromise which will give a practical answer.

The aerials for mobile work are a good example of this. Here we strike an immediate limitation of size when we think of aerials for mounting on a vehicle. As we can't drag lengths of wire along the road, we must use vertical rods, and if we make them more than about 12ft high we are apt to hit the branches of trees, or overhanging wires, &c.

Now the best aerial length particularly for transmitting bears a direct relationship to wavelength. If we



Sketch showing how the aerial loading coil is made up.

regard a quarter-wave aerial as the shortest length with any efficiency, we would require at 3.5 Mc a vertical aerial of about 66ft high! Obviously we couldn't run a car with such a whip attached.

In the past it has been a practice to use a whip as long as possible, and to make up the shortage in length by means of a special aerial tuning unit. Unfortunately, the portion of the aerial which radiates most effectively is represented by the tuning unit, and the whip doesn't do a very good job.

The latest technique is to use a vertical whip, but instead of the tuning unit, to add a coil directly to the whip length to make up approximately a quarter wavelength in an electrical sense. The coil may be placed at the bottom of the whip, somewhere along its length, or even at the top, each of which positions has its advantages.

Unfortunately, to explain the operation of the loaded whip would take quite a bit of space, and would undoubtedly be over the heads of many readers. We are more interested in telling you how to make a workable version of such an aerial, and suggest that if you would like to examine the theory more closely, and perhaps work out some versions of your own, you read the relevant chapter in the 1952 edition of the ARRL Handbook, a publication which any radio minded man should have anyhow.

AERIAL DESIGN

In the meantime, if you consider the loading coil as portion of the aerial rolled up into a coil to save space, that will do as a rough and ready background.

An aerial representing a quarter-wave type radiates best from the bottom end, and therefore it is best to mount the coil so that the bottom end is represented by part at least of the whip. Unfortunately as we move the coil up the whip, its electrical characteristics become more and more critical, its size for a given frequency increases, and its weight will cause the whip to sway around too much.

It is generally accepted that about one-third to one-half way up the whip is optimum for the coil position. The actual length of the whip isn't particularly critical, as the coil eventually provides the tuning. We would say that 12 feet is about optimum — more if you can manage it—but not too much less, with the centre of the coil 4ft from the bottom.

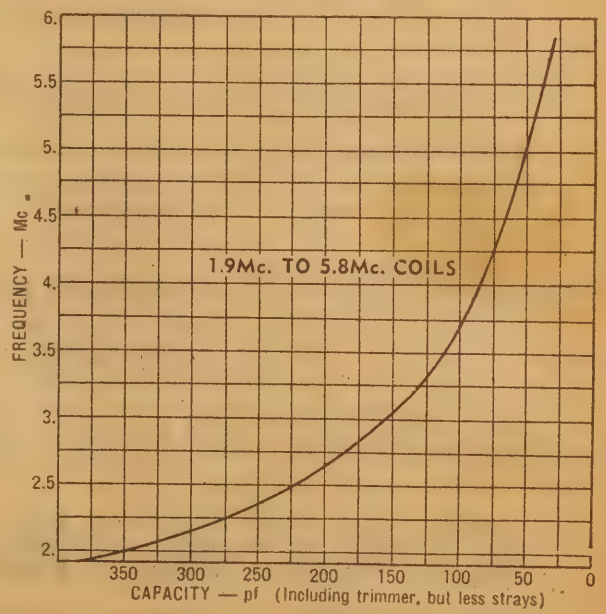
Mounting the whip is rather a problem, and you may have to work out your own solution. A good solid insulator mounted to the vehicle is the first need, followed by a stout tube

(Continued on Page 38.)

	1.9Mc. TO 5.8Mc. NOMINAL PADDER .0016mfd.	2.2Mc. TO 6.5Mc. NOMINAL PADDER .0018mfd.
	AER.	
G, A, E, AVC	48T. 32 Gauge SWG Enam. Closewound. (Length approx. 9/16")	41T. 32 Gauge SWG Enam. Closewound. (Length approx. ½")
	11T. 35 Gauge SWG Enam. Closewound over tuned winding.	10T. 35 Gauge SWG Enam. Closewound over tuned winding.
	RF	
G, P, B, AVC	48T. 32 Gauge SWG Enam. Closewound. (Length approx. 9/16")	41T. 32 Gauge SWG Enam. Closewound. (Length approx. ½")
	22T. 35 Gauge SWG Enam. Closewound over tuned winding.	20T. 35 Gauge SWG Enam. Closewound over tuned winding.
	OSC.	
P, E, G, PAD	39½T. 32 Gauge SWG Enam. Closewound. (Length approx. ½")	34½T. 32 Gauge SWG Enam. Closewound. (Length approx. 7/16")
	11T. 35 Gauge SWG Enam. Closewound over tuned winding.	10T. 35 Gauge SWG Enam. Closewound over tuned winding.

32 SWG approx. equivalent to 29 B&S. 35 SWG approx. equivalent to 33 B&S. All coils wound in the same direction. Layer of plastic tape over tuned winding before adding 35 Gauge winding.

The first column gives coil data for intra-shire frequencies near 2 Mc nd the second for those near 6 Mc. This data ensures that the tuning gang will have the necessary coverage to accommodate both extremes.



This graph allows you to approximate the total capacitance across the switched receiver coils for frequencies between 2—6 Mc. This capacitance is made up by normal trimmer plus a small mica condenser if required.

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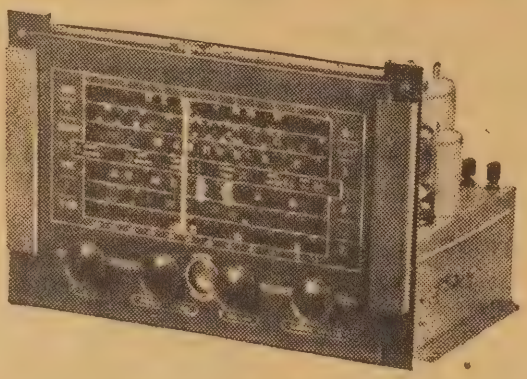
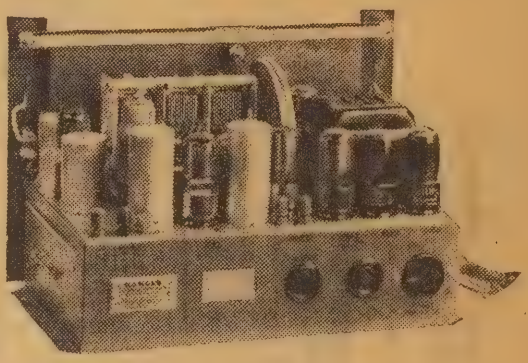
9-Valve De-Luxe Dual-Wave Radiogram-Chassis

Including Magic-Eye Tuning Indicator With Matched Dual Speakers

FREIGHT EXTRA





COMPARE THESE FEATURES

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- High gain audio with push-pull output and tone control gives you high fidelity reproduction from both radio and your favorite recordings. Inverse feedback incorporated.
- Power switch is fitted to the tone control of all chasses thus enabling the power to be completely switched off from the set. Radiogram switch combined with wave change switch.
- Tuning is made simple and positive even on overseas stations by the use of a super sensitive magic eye tuning indicator.
- All chasses are wired for the fitting of an F.M. or Tape Recorder. Special plug on back of chassis being provided, also standard 3-pin socket for power supply to motor.
- Speakers supplied are Magnavox 12in and 8in permanent magnet with tropic proof transformer.
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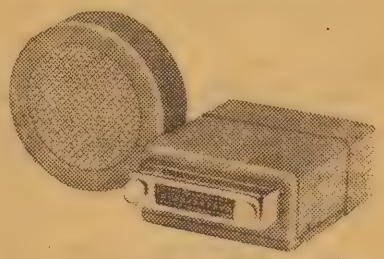
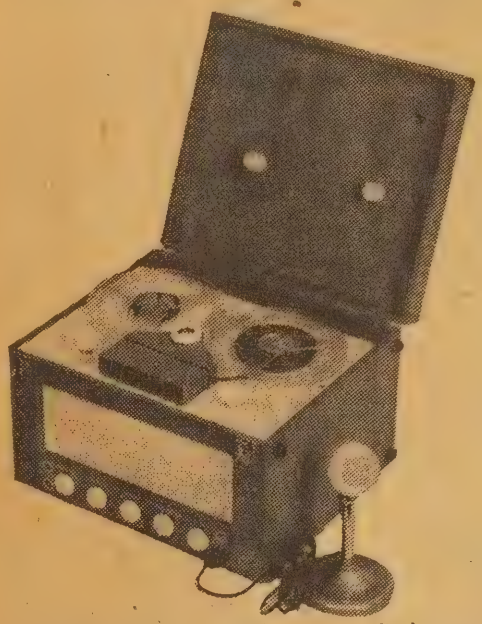
- Battery consumption, 2.8 amps at 12 volts and 4.6 at 12 volts.
- Size has been reduced to a minimum. Set measures 9" x 7¼" x 3¼" deep.
- Both units, set & speaker are finished in bronze hammertone with chrome dial fittings.
- Special dial fittings are available for Holden cars and utilities.
- Heavy duty six or eight inch speaker supplied.
- Set supplied complete with cowl or side mounting aerial and lead.



PRICE **£37/10/-** F.O.R.

"FERROMASTER" TAPE RECORDER



The Ferromaster tape recorder is supplied complete with crystal microphone and stand, and is fitted in durable, attractive plastic-covered carrying case with space for radio tuner, microphone and tape.

PRICE **£99/10/-** F.O.R.

A specially designed radio tuner for the Ferromaster Recorder is available at £9/15/- extra.

The Only Unit with ALL These Features:—

- TWIN TRACK (GIVING TWO HOURS PLAYING TIME ON ONE TAPE).
- DUAL SPEED (7½ and 3¾in PER SEC). SPEED CAN BE CHANGED BY THE FLICK OF A KNOB WHILE UNIT IS IN OPERATION IF REQUIRED.
- FAST FORWARD.
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- POSITIVE BRAKING.
- THREE MOTORS.
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- INPUT FOR MICROPHONE, PICK-UP. OR RADIO.
- PROVISION FOR EXTENSION SPEAKER.
- RECORDING LEVEL INDICATOR USING "MAGIC EYE".
- TAPE INDICATOR CALIBRATED IN MINUTES.
- FULLY GUARANTEED.

BUSH FIRE MOBILE EQUIPMENT

(Continued from Page 35)

up to the coil. If you have a very flexible top section, the bottom may be rigid. If not, some spring loading will allow it to "give" if you hit an obstacle, with less likelihood of damage. But do your best not to hit anything!

We used sections of a disposals tank-type whip made of copper-plated light-weight steel, and this is about the best of all. Others use brass tubing for the bottom section, and a collapsible car-type aerial for the top.

The coil itself is wound on a bakelite or impregnated cardboard former one inch in diameter. This former is fitted with two brass plugs turned up on a lathe to a close fit in the tube, and secured by bolts tapped into the brass. The plugs are drilled to take the bottom and top sections of the aerial. The bottom section may be made a permanent fit, but the top should be locked in place by set screws, &c., so that it can be removed when not required.

CONSTRUCTIONAL

The plugs provide flanges so that a second tube of 1¼ inches inside diameter can be slipped over the first to protect the winding. It also provides extra bracing, although if thick-walled tubing is used, you'll be surprised how strong it is.

The ends of the coils are connected to the brass plugs at each end which in turn make connection to the whip sections.

For theoretical reasons, the best coils is one with a very high Q, wound on low-loss former or large diameter. Such a coil is hard to make, heavy, and very critical to adjust. Our coil should represent a good compromise, and we found it very much better than a plain whip, or a bottom loaded type.

The number of turns on the coil will vary greatly over the large frequency variation of 2 - 6 Mc. Our tests were made on 3.5 Mc and our coil had about 140 turns of wire. A rough idea of the number of turns can be obtained if you work out the length of a quarter-wave at the operating frequency, allow for the length of the whip, and wind the remaining length of wire on the coil For the lower frequencies up to 2 Mc, the wire should not be more than about 20 gauge for a reasonable coil length, and up to 16 gauge for 3.5 Mc and higher.

COIL ADJUSTMENT

The coil is adjusted by tapping the connection to the bottom section along the coil until a spot is reached at which the transmitter loads to the correct plate current with the aerial tapped nearest the bottom of tank coil, and with the smallest reaction on the transmitter tuning as compared with the dial setting with no aerial attached. This will probably be critical to a couple of turns, but should not be very hard to find. The excess turns can be removed, and the former shortened to provide the most compact coil. Do not wind over that portion of the former occupied by the brass plugs at each end, that is, no nearer than about 1½ inches from top and bottom. The enamel insulations is removed from the wire for tapping, avoiding shorted turns, a temporary slider is a help during adjustment.

Some experiment with base station aerials will be a good thing. To allow both vertical and horizontal radiation, a single wire aerial, an odd multiple of a quarter-wave would probably be best, arranged so that about half its length runs vertically and the remainder horizontally. Do not install the base near sources of electrical noise such as garages, power stations, neon signs, &c., as a quiet location can easily double your range when signals are weak. Alternatively a half-wave aerial link coupled with 72 ohm twin feeder and mounted at an angle of 45 degrees should give good results. Extreme height is not necessary.

BASE STATION EQUIPMENT

Because the aerial systems at the base station are generally much more efficient than those at a vehicle, an input power of about 20 watts should be capable of radiating a satisfactory signal in most cases. As the availability of AC power does not limit us in the matter of power consumption, it is possible to build for reasonable cost a more powerful transmitter than this. The PMG will usually issue a licence for an input power of up to 50 watts, and many prefer to use as much power as they can, on the reasoning that the loudest signal is always preferred for maximum intelligibility, particularly with a whip aerial at the other end.

Conversely it is argued that the best possible receiver should be used at the base station to make the most of the weaker signal from the mobiles and their inferior aerial systems. This again is reasonable, although in many cases, intelligibility on talk back is often limited more by electrical and atmospheric noises than by receiver sensitivity alone.

MORE ELABORATE GEAR

It is not hard to build a more elaborate transmitter and receiver for the base, and cost isn't such a factor, remembering that only one installation is required for each network. We would be prepared to consider the design of more elaborate equipment for a base station for description in Radio and Hobbies if enough readers ask for it. It is in fact rather an interesting project, particularly the receiver, where much could be done to reduce extraneous noise by reducing both RF and AF bandwidths.

We have already described both transmitters and receivers for amateur use which would perform very well for a bigger base installation, and many amateurs who might build it are likely to be familiar with these descriptions.

There is virtually no limit to the time and trouble one can spend on such things. Our task is to judge how far elaboration is justified, and what is in fact an optimum design. It is hard to please everybody.

In the meantime, we would be most interested to hear from anyone who builds up the equipment detailed in the last two issues, together with any problems they may have encountered.

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For the ultimate in Tape Recording we are now able to offer all components for building Tape Recorders to the exact specifications of Bradmatic Ltd., of England. In stock at the moment, while they last, are supplies of the world famous Bradmatic Heads — the standard by which others are judged.

TECHNICAL DETAILS!

HEADS TYPE 5RP: Twin track, single hole mounting. Track width .09in. Gap .0004in. Response at 7½in, 30-11 Kcs.

TYPE 6RP: Similar to above except Gap .00024 and considerably wider frequency response.

TYPE 5E: Gap .004in. Track width .105in. Erase frequency, 30-100 Kcs.

PRICES: 5RP and 5E .. £6/3/-
6RP £7/3/-

Full technical details and circuits for all units available on request. We can also offer the following items for the really discriminating enthusiasts:—

Sets of oscillator coils, miniature in size, but giants in performance as designed by Bradmatic at £3/-/- per set.

Complete oscillator sub-assemblies on aluminium chassis, with highly efficient Noval tubes at £7/10/-.

Completely wired and tested units are available for all other applications. e.g. Record amplifiers, play-back pre-amplifiers and monitor amplifiers.

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Flying radar

THE Lockheed Aircraft Corporation is building a fleet of flying radar stations.

They can locate enemy targets at greater distances than conventional ground radar stations.

Both the US Air Force and the Navy have ordered the airborne radar stations, which are special versions of the Lockheed Super Constellation plane.

INDUSTRIAL ELECTRONIC AIDS

This second article in the series on Industrial Electronic Aids describes a variety of typical devices, including methods of moisture control, smoke detection, turpidity and color, oil analysis and such like.

PART 2

IN various industries, the moisture content of the product must be controlled with great care and precision. An outstanding example is in the last stage in paper manufacture. Moisture studies are carried on electronically by means of the precision hygrometer.

The basic principle of operation of this instrument is illustrated by figure 6.

VARIABLE CONDENSER

The chief electrical component consists of a special condenser comprising the highly stationary plate, T1, and a movable plate T2, so arranged that a spring tends to pull the movable plate toward the stationary one against the action of a ribbon of cellulose acetate.

Cellulose acetate ribbon is unusually sensitive to variations in the moisture content of samples brought close to it. As the ribbon quickly absorbs or loses moisture content of

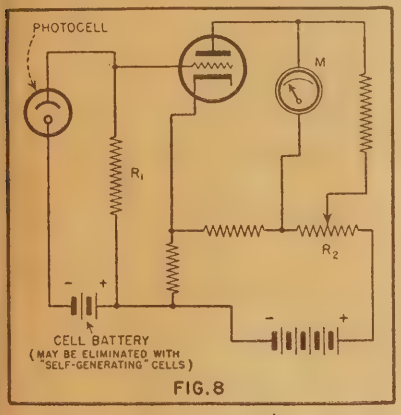

FIG.8

a nearby sample, its length is quickly altered proportionately.

The sample does not come in contact with the ribbon.

In the arrangement of figure 6, the changes in length of the acetate ribbon produce corresponding changes in separation between T1 and T2.

If the plates are connected across the tuned circuit of the variable oscillator in any of the circuits shown in figures 1 to 3, the oscillator frequency will be varied in accordance with the changes in ribbon length (moisture content).

MOISTURE OPERATED

In practice, a long strip of manufactured material, such as paper or cellophane, passes near the acetate ribbon as it progresses from one stage to another of the fabricating machines. Baffles are strategically placed to protect the sensitive ribbon from moisture other than that in the sample.

The oscillator circuits are connected to an indicating meter, such as shown in figures 1 to 3, or their output voltages may be amplified to regu-

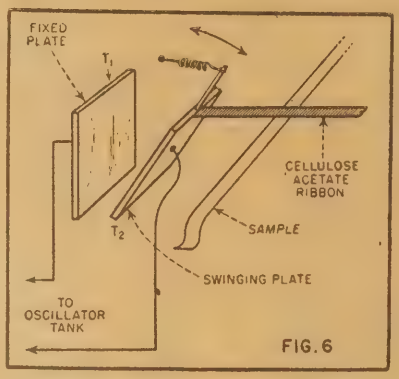

FIG.6

late steam jets or air streams for correcting the moisture content of the sample.

If desired, a suitable recorder may be connected in lieu of an indicating meter to obtain a continuous running record of moisture content. This recorder may be actuated simultaneously with the jet-controlling mechanisms.

SMOKE CONTROL

Many cities in the world have enacted ordinances prohibiting heavy industrial stack smoking except for intervals of stated duration during any single hour.

Automatic photo-electric systems are in use to keep the boiler room constantly informed of the density and time of smoking by suitable signal lights, bells, or indicating gauges.

A further refinement consists in arranging the system to check dampers and stokers automatically after excess smoke has issued from the stack for the prescribed period of time.

Apparatus for translating changes in smoke density into electrical impulses of suitable voltage for practical purposes is shown in figure 7.

LIGHT SOURCE

A light source, such as a protected incandescent lamp, is mounted in a housing on one side of the stack and directs a beam of light through the ascending smoke to a photocell mounted in a similar housing on the opposite side of the stack. The photocell is connected to the input circuit of an amplifier which delivers voltage across a load circuit proportional to variations of the light beam.

These variations are in turn proportional to those in smoke density. The output voltage is made sufficiently high to actuate the alarms or draft-control mechanisms by appropriate choice of amplifier constants or by the use of Thyratron or grid glow tubes after the amplifier.

With a similar electronic circuit, chemical laboratories may investigate the turbidity of solutions quantitatively with greater precision than is possible with the eye.

As in the preceding application, a light source (preferably followed by an appropriate optical filter) is placed on one side of a transparent sample container; a photocell on the opposite side. The cell is connected to a resistor of several megohms and the voltage drop across the latter due to cell current is measured with a sensitive vacuum-tube voltmeter.

The meter scale may be graduated in suitable units of turbidity to give a direct-reading instrument, since voltage variations will be directly proportional to variations in solution turbidity.

METER INDICATOR

If a self-generating cell, such as the photronic cell, is employed, a sensitive DC microammeter may be used directly without vacuum tubes to indicate the cell-current variations. This arrangement will be recognised at once as identical with that of the

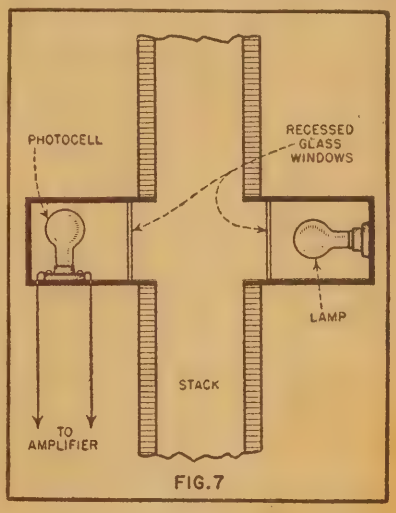

FIG.7

well-known photographic exposure meter.

The simple turbidity meter is useful also for studying acidity and alkalinity of solutions by measuring the relative coloration of sample

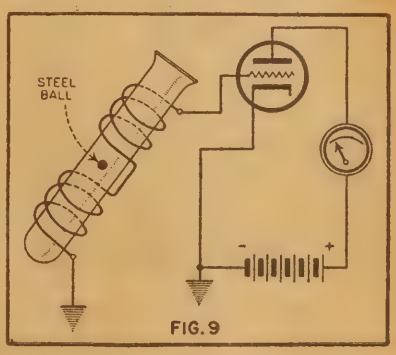

FIG.9

STANDARD -FERGUSON- RANGE

RECEIVER POWER TRANSFORMERS

CODE NO	PRIMARY VOLTS	HTV aside	HT mA	FILAMENTS
PF185	240	150	30	6.3V/2A
PF299	240	285	40	6.3V/2A, 5V/2A
PF300	240	325	40	6.3V/2A, 5V/2A
PF201	240	225	50	6.3V/2A

NOTE: All transformers are available with upright mounting. The following 9 transformers are also available with flat mtg., fitted with an adaptor plate to suit 3 x 3½in centres. On removal of plate, mtg. centres become 2½ x 3 1-8in. If flat mtg. is required afix Code No by letter F e.g. PF151F.

PF151	230, 240	285	60	6.3V/2A, 5V/2A
PF166	230, 240	325	60	6.3V/2A, 5V/2A
PF165	230, 240	385	60	6.3V/2A, 5V/2A
PF170	230, 240	285	80	6.3V/2A, 6.3V/2A, 5V/2A
PF169	230, 240	325	80	6.3V/2A, 6.3V/2A, 5V/2A
PF168	230, 240	385	80	6.3V/2A, 6.3V/2A, 5V/2A
PF130	230, 240	285	100	6.3VCT/2A, 6.3V/2A, 5V/2A
PF164	230, 240	325	100	6.3VCT/2A, 6.3V/2A, 5V/2A
PF160	230, 240	385	100	6.3VCT/2.5A, 6.3V/2A, 5V/2A
PF152	230, 240	285	125	6.3VCT/3A, 6.3V/2A, 5V/2A
PF163	230, 240	325	125	6.3VCT/2.5A, 6.3V/2A, 5V/2A
PF181	230, 240	385	125	6.3VCT/3A, 6.3V/3A, 5V/2A
PF174	230, 240	285	150	6.3VCT/2A, 6.3V/2A, 5V/2A
PF142	230, 240	325	150	6.3VCT/2A, 6.3V/2A, 5V/3A
PF175	230, 240	385	150	6.3VCT/2A, 6.3V/2A, 5V/3A
PF167	230, 240	385	150	6.3VCT/2A, 5V/3A, 2.5VCT/5A
PF173	230, 240	425	175	6.3VCT/3A, 6.3V/2A, 5V/3A
PF140	230, 240	385	200	6.3VCT/3A, 6.3V/3A, 5V/3A
PF171	230, 240	385	250	6.3VCT/4A, 6.3V/3A, 5V/3A

POWER AMP. AND LOW POWER T/MITTER UNITS

PF172	230, 240	500	200	6.3V/4A, 6.3V/3A, 5V/3A
PF143	230, 240	600 500	200	2.5V/5A, 2.5V/5A, 5.5V/.5A
PF147	200, 230 240, 260	1000 750 500	200 250 300	5.5V/.3A
PF179	230, 240	475	225	6.3VCT/4A, 6.3V/2A, 5V/3A
PF107	230, 240	585	250	6.3V/3A, 6.3V/2.5A, 5V/3A

C.R.O. TRANSFORMERS

PF188	240	350 one ext. 900	30 2	6.3V/2A, 6.3V/1A 5V tap 4V/2A 4V tap 2.5V/2A
PF545	240	350 one ext. 1000	20 1	6.3V/3A, 6.3V/.6A, 4V tap 2.5/2A

TAPE-RECORDING TRANSFORMERS

PF642	230, 240	250	80	6.3V/3A, 5V/2A Low radiation
PF664	240	265	80	6.3V/3A, 5V/2A Low radiation

PHOTOFLASH TRANSFORMERS

HT119	200	4000 ½ wave	
HT131	240	1100 ½ wave	prim. also vib, 5.2 or 4V

POWER CHOKES

CODE NO	IND HY.	DC RES.	DC MA	CODE NO.	IND HY.	DC RES.	DC MA
CF100	50	1900	10	CF112	10	70	250
CF101	30	870	25	CF113	5/20	70	50/250
CF102	15	300	60	CF115	.017	.6	2A
CF103	30	420	60	CF119	.005	.1	6A
CF104	30	580	80	CF162	10	90	330
CF105	15	250	80	CF196	20	130	125
CF106	12	200	100				
CF107	30	360	100	CF114*	40 watt fluor ballast		
CF108	12	135	150	CF213*	20 watt fluor ballast		
CF109	20	225	150	* Fitted with rubber mounting to reduce hum. Standard 5¼in hole centres.			
CF110	12	100	200				
CF111	16	165	200				

VIBRATOR AND A.C. POWER TRANSFORMERS

CODE NO	PRIMARY VOLTS	HTV aside	HT mA	FILAMENTS
PF182	240AC 12VIB	200	40	12.6/1A
PF122	240AC 6VIB	220	40	6.3V/2A
PF125	240AC 6VIB	250	60	6.3V/2A
PF126	240AC 12VIB	250	60	12.6VCT/1A
PF119	240AC 6VIB	325	125	6.3V/4A
PF146	200, 230, 240 AC 12VIB	325	150	12.6VCT/2.5A

VIBRATOR TRANSFORMERS

CODE NO	PRIM VOLTS	DC Volts	O'put mA	Buffer Full Sec	
VT101	6	90	15	.008	
VT102	6	150	25	.005	
VT103	6	200	50	.005	
VT127	6	200	50	.005	Low radiation. Car Radios
VT104	6	250	60	.005	
VT107	6	250	60	.005	Low radiation. Car Radios
VT106	6	300	75	.008	
VT122	6	400	50	.005	
VT146	12 or 6	240AC	50w	IMFD	For Emergency light, etc.
VT112	12	200	50	.005	
VT132	12	200	60	.005	Low radiation. Car Radios
VT105	12	250	60	.005	
VT117	12	250	60	.005	Low radiation. Car Radios
VT114	12	300	75	.008	
VT123	12	320	125	.005	
VT113	24	200	50	.005	
VT116	24	250	60	.005	
VT115	24	300	75	.008	
VT119	32	150	25	.005	
VT100	32	200	40	.005	
VT124	32	250	60	.005	

FILAMENT TRANSFORMERS

CODE NO	PRIMARY VOLTS	SEC. VOLTS
PF118	220, 240, 260	2.5V/5A, 2.5V/5A
PF158	220, 240, 260	5V/8A
PF476	240	6.3V/3A
PF138	220, 240	6.3V/4A, 5V/4A, 2.5V/4A, 2.5V/4A
PF162	240	6.3V/3A, 6.3V/3A
PF154	200, 230, 240	7V tap 6V/7A, 6.3V/3A, 5VCT/5A 5V/3A, 2.5V/7A
PF102	240	7.5V/2A
PF111	240	10V/5A
PF211	200, 230, 240	10VCT/10A
PF131	230, 240	10VCT/10A, 5V/15A
PF123	240	15, 12, 8, 6V/1.8A
PF439	240	32V 60W Enclosed one outlet
PF457	240	32V 125W Enclosed two outlets
PF491	240	32V 200 W Enclosed two outlets

BATTERY-CHARGING TRANSFORMERS

CODE NO	PRIMARY VOLTS	SEC. VOLTS
PF265	230, 240	17V tap 11.5, 10, 8.5/4.2A
PF389	230, 240	17, 11.5, 10, 8.5V/4.2A, 17, 11.5V/4.2A 17, 11.5V/4.2A
PF537	240	17V tap 11.5V/0.4A

BELL TRANSFORMERS

CODE NO	PRIMARY VOLTS	SEC. VOLTS
PF648	240	10W Continuous or 2A Intermittent.

Fully enclosed including 240V socket and outlet terminals. Designed to operate local and imported chimes as well as various types of bells.

IN ADDITION TO THE ABOVE RANGE, A STANDARD RANGE OF OUTPUT AND MODULATION TRANSFORMERS IS AVAILABLE

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solutions to which have been added an indicator such at litmus of phenolphthalein. However, efficient colorimeters may assume more complex configurations, as will be shown.

It has been stated that a relatively simple photo-electrically operated voltmeter, intended for turbidity measurements in chemical analysis, might be used as a rudimentary colorimeter.

Figure 8 shows the circuit of an instrument which is applied to the simple measurement of colors. The resistance, R1, is very high in value, generally of the order of 50 megohms.

The photocell is actuated by a light beam passing through a test film on which is smeared the sample color and produces a voltage drop across R1 proportional to the amount of light reaching it.

SIMPLE VT VOLTMETER

The tube circuit is that of a simple vacuum tube voltmeter which measures the voltage drop across the resistor. The DC micro-ammeter, M, is connected in a bridge circuit of which the tube plate resistance is one leg. By adjustment of another leg, R2, the steady plate current of the tube is initially balanced out to set the meter circuit to zero.

The limitations of such an instrument are severe, since the simple photo-voltmeter is incapable for the most part of distinguishing between color changes and density changes. Nor, when it is operated by reflected light from solid samples, can it be easily isolated from sample-surface effects, directional light effects, and variations in illumination.

Moreover, color waveforms are generally complex and the simple instrument cannot show the relative amplitudes of each light-frequency component. The restrictions of the instrument are comparable to those of the audio harmonic totaliser against the advantages of the complete wave analyser.

COLOR ANALYSIS

Complete analysis of colors and precise color-matching are made possible by the ingenious color comparator. These instruments are analagous to the audio-frequency wave analyser in that they make it possible to explore a complex visual waveform, measuring the amplitude of each component.

The necessarily high order of selectivity is obtained with optical filters; and when the separate readings for two samples are identical, the two match perfectly in hue, saturation and brilliance.

The commercially available color comparator operates in the following manner: Three light-frequency bands corresponding to the red, blue and green regions, are selected for measurement from the complex color waveform by means of optical filters, and a measurement is made separately in each band of light reflected from the sample. The three readings give an effectively complete account of the color.

OIL ANALYSIS

The petroleum industry has borrowed some of the apparatus and methods long employed in dielectric measurements in the condenser industry to study oil characteristics more closely. At the same time, certain electronic equipment has been designed primarily for use by oil refiners in their research work.

Measurements are now being made electronically of several oil characteristics, including viscosity, dielectric constant, power factor, lubricating quality, electrical resistance, gasoline "knock" properties and hydrogen ion concentration (pH).

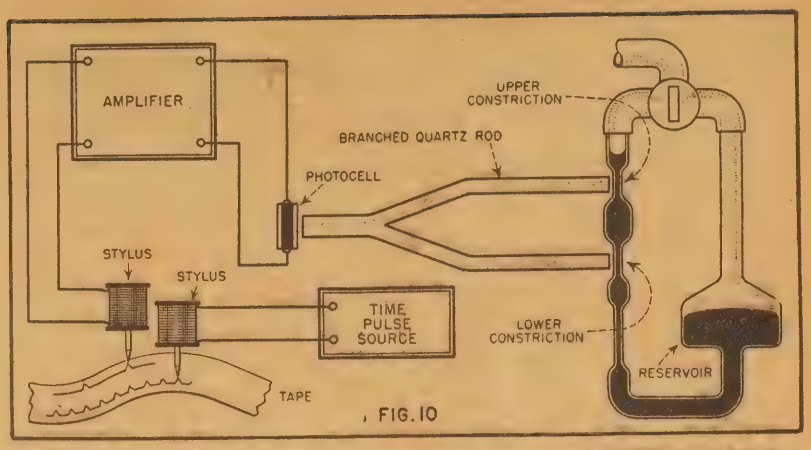

FIG. 10

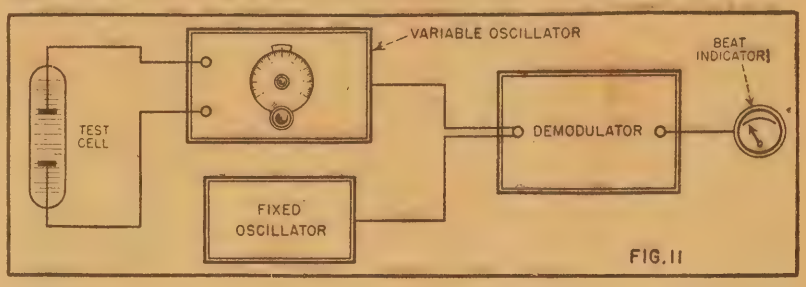

FIG. 11

Viscosity has been measured by several methods, one of the first of which is illustrated in Figure 9. In this instance, the viscous liquid is retained by an inclined glass tube, the lower end of which is closed, and around the outside of which are wound two solenoids.

The ends of the series-connected coils are connected to grid and ground terminals of a vacuum-tube circuit, and a DC milliammeter is included in the tube plate circuit.

With the circuit in operation, if a steel ball is dropped into the liquid, it will pass from the surface to the bottom at a rate of speed dependent upon the viscosity of the liquid.

As the ball passes through the two coils, there will be two corresponding deflections of the plate milliammeter and the ensuing time interval may be measured. The viscosity is determined from the time taken by the ball to travel a given distance through the liquid.

For accuracy, the angle of inclination of the test tube must be adjusted with reference to the temperature.

A set-up for the chronographic study of viscosity is diagrammed in Figure 10.

VISCOSITY STUDY

The sample liquid is drawn up from a reservoir into a glass capillary tube with two narrow constrictions near its top. Solid quartz rods are arranged between these constrictions and a photocell, as shown, for the purpose of communicating impulses to the cell from light beams directed through the constrictions.

The tube and reservoir are immersed in a constant-temperature bath.

As the liquid slowly falls in the tube, its meniscus interrupts the light beam as it passes successively through each constriction, and the resulting electrical pulses are delivered by the photocell to an amplifier.

An electromagnetically-operated

(Continued on Page 111)

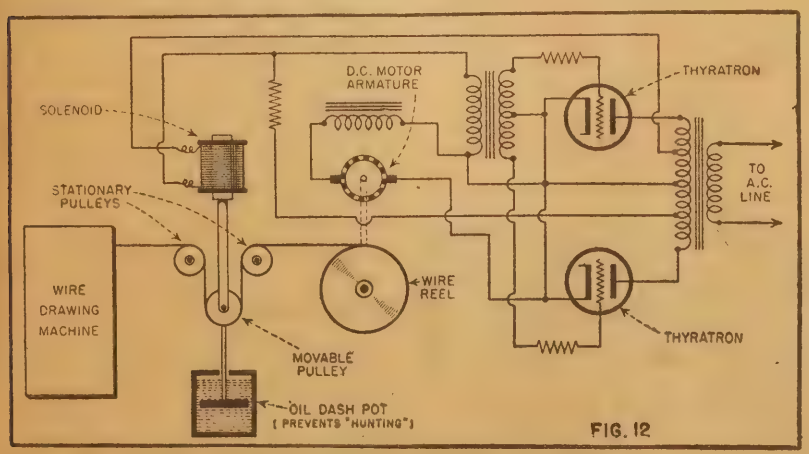

FIG. 12

Let's Buy An Argument

Have you heard this one? I mean the latest joke about theory being different from practice? Remember, we had a lot of talk about the subject some time back? No, I won't tell it as a joke, I'll try to keep a straight face!

by W. N. Williams

IT began a few weeks ago when a very good friend, in trying to record a program for subsequent broadcast, struck some untimely trouble in his tape recorder.

Having set all his gear up and done a good job of monitoring, he was staggered to realise afterward that there had been a fault in the erase circuit. Instead of the machine erasing automatically the earlier program on the tape, it remained as a faint but annoying background to the wanted material. The tape looked like being a dead loss.

BRIGHT SUGGESTION?

Then it was that a second technician friend came up with a bright suggestion. Why not play the tape at very low volume and re-record it on a second machine at normal volume? By so doing it would drop out the low-level background!

I made a few standard remarks about "pulling the other leg", but realised that he was quite in earnest. He assured me that it was commonly done in broadcast circles and that it really worked out "in practice".

In vain did I argue that, even though the playback level was restricted, it had to be offset by piling on that much extra gain in the re-record channel. Both the wanted and the unwanted signals would thus be transferred from one tape to the other without any change in their relative levels.

"I know all that," he maintained; "I know it shouldn't work in theory, but it does work out in practice! Anyway we'll give it a go." Which he did and, although I didn't hear the end result, I was assured that the unwanted program was substantially attenuated and tape duly broadcast.

Now I've never had occasion to check the procedure myself, and I must take other people's word that it really works. But if it does happen "in practice", then we simply have to evolve some theory to explain it.

During the course of argument, one explanation went like this: "Magnetic heads don't seem to be as sensitive to weak signals as they are to strong ones."

"You mean they are non-linear, that they "kink" the waves in the low magnetisation region?"

"No, not exactly. Of course it might be the tape."

"It amounts to the same thing."

WHAT IT MEANS

That, of course, is the whole core of the matter. If you suggest that any element at all in the tape recording chain favors strong signals rather than weak ones, you are simply saying that the particular element is non-linear in its transfer of magnetic field to signal voltage or vice-versa.

That means, as I said before, a definite kink in the sides of all waveforms adjacent to the low magnetic intensity region. If you won't have this possible libel of the equipment, then you must reject also the "discrimination" theory.

My own explanation of what happens—if indeed it does happen—would depend purely on signal-to-noise ratio. It would work something like this:

Let's say an average program has a total noise 60 db below program level. The precise figure doesn't matter.

Owing to the erase failure, the original program may have been reduced by only 40 db, leaving it 40 db below program level, but a clear 20 db above background noise. At intervals it might thus be clearly audible.

The original is now played back at very low level and re-recorded with the gain of the second recorder turned well up. Valve and circuit noise may then be apparent and the new tape, while containing the desired program at normal level, might also have noise background say only 40 db down.

In with this, and at comparable level, will be the interfering signal.

LOST IN NOISE

The listener who hears the tape may or may not notice the higher background noise, depending on his receiving set-up. What is more important, he is much less likely to

notice the interfering signal, because all but the loudest peaks will be continuously masked. The real trouble comes with an interfering signal when it is so continuous that you unconsciously start to listen to it.

That is my theory, but there may be more to it.

But if the theory is correct, exactly the same results could be obtained, from the listeners' point of view, by playing the original tape and feeding the program line simultaneously with signal from a "white noise" generator.

In fact, you might get enough masking signal for the purpose by opening a parallel channel into the line far enough to introduce circuit noise.

Or yet again, for all I know, the whole idea may be a "furphy".

REACTIVATION

Coming now to the letters elsewhere on the page, I must first offer a word of explanation about the heading.

It was pencilled on to the layout page with no other intention than to occupy the appropriate space and convey the required meaning with a touch of humor (R. and H. brand). After all, one gets awfully tired of traditional headings like, What Our Readers Say!

It was only on a further look that I appreciated its possible secondary implication. I can only assure the readers concerned, or others who might write, that we have no intention of consigning their literary efforts to the flames.

On the subject of reactivation, it is quite true that commercial reactivators have been offered overseas which presumably charge the cells at a rate equal to or higher than the normal discharge rate.

We have even heard mention of "fast charging" dry cells!

RECOMMENDED PRACTICE

Some cells might take it, but a lot of others might not. And the cells which would take it are not necessarily the best in other respects. At this stage it seems more logical to abide by the recommendations of a battery manufacturer, as published last month.

We certainly did not appreciate the possibilities, nor the implications of reactivation when we published the circuit referred to by H.P. in the October, 1948, issue. By sheer coincidence it is being reprinted in this issue, in the article on modernising battery sets. (Vide, "Personal Power Supply").

In this circuit it would be possible to charge the dry cell to higher than 1.5 volts, only if it were connected to the power supply for a lengthy period, with no filaments drawing current.

However, we were careful to point out the need for switching the set off both at the power point and at the receiver, thus ensuring that the cell would neither be overcharged nor discharged. We also suggested replacing the cell, should the filament voltage show any signs of rising.

In practice, there should be little risk of the cell being overcharged. The AC supply is barely able to deliver the requisite voltage under normal load and the current through the cell hovers around zero most of the time, showing a slight charge or discharge, according to the actual load and the mains voltage.

We've never had reason to question the operation of the circuit since it was published. At least one commercial set we have seen "floats" its A battery in this exact fashion during AC operation and the scheme appears to work satisfactorily.

While still on the subject of reactivation, Mr. Adams, of the Eveready Company has made a further point which I don't think has been stressed as it might. He points out that the practical advantages of reactivation are most likely to be realised with small capacity batteries.

In most cases, a universal portable will only be used on batteries during weekends and, for a total period of say six hours. It would take many months of use at this rate to run down a set of batteries, by which time they should have deteriorated anyway through sheer old age!

The fact that they mightn't do so is a supreme tribute to the manufacturers. In fact, in the face of a temporary shortage, a lot of our tests on the "Jubilee" portable, mentioned elsewhere in the issue, were actually conducted with a reactivated battery just on two years old!

However, to come back to the original theme, small low capacity

SOME MORE FUEL FOR THE FIRE

REACTIVATION

In reply to an article in "Let's Buy an Argument" in last month's Radio & Hobbies, re Reactivation of Dry Cells, G.N.W., of South Yarra states:- "For instance about a year ago I read a par in a Braille magazine about a device to be manufactured in Britain to recharge batteries used in deaf aids."

Some time ago I read in an American magazine an advertisement for a reactivator for radio batteries which would recharge the batteries by connecting them to the reactivator for a period equal to the time for which they are discharged.

I would like to draw your attention to an article on page 61 of October, 1948, Radio & Hobbies, and would like to know why the voltage of a 1½ volt battery used instead of a condenser could not rise above 1½ volts thus damaging the filaments of the valves should there be an increase in voltage or reduction in the currents drawn through faults in the set. (H. P. Footscray, Vic).

ARGUMENTS

I would be very pleased if you are able to answer the following two questions. Both questions were the results of arguments with other chaps and I would be very grateful if you are able to answer them.

Question 1. Do any manufacturers use wax in their power transformers; if so for what reason?

Question 2. Are there any advantages in placing the gain or volume control in the plate circuit of an amplifier instead of the grid circuit, as I have noticed in many amplifiers. Would a noisy volume control be one reason? (D. S. Bathurst, NSW).

A NEW SUBJECT

I have followed, since its inception your series "Let's Buy an Argument", with much interest and an article like this is to a greater or less extent only as good as your correspondents make it.

Getting onto new ground, for this article I refer you to the anti-noise aerial system which was published in Radio & Hobbies a few months back. The part that interests me is the portion of the system other than the anti-noise section or the aerial proper.

Quoting Radiotron Designer's Hanabook, page 896 "The horizontal portion of a medium-frequency receiving . . . aerial plays no useful part except to increase the efficiency of the coupling."

Now in practically all cases a straight vertical aerial is most efficient from medium-frequency broadcast reception as the transmitting aerials are vertical and the radio waves are vertically polarised.

Thus a vertical aerial increases the pick up of wanted signals to a maximum and in most cases does not increase the pick up of noise from man-made interference.

I don't remember the set you were using but you mentioned the reception of Wollongong and Katoomba in the daytime. Off hand I don't know the distances of these from Sydney but should judge them to be about 35 and 50 miles.

Here we depend on stations that distance nearly for our only service. 6WA is about 35 miles by road and I guess a little under 30 miles direct. No aerial is necessary at all to get 6WA at reasonable entertainment level. 6WB would be 35-40 miles direct, the same applying to 6NA, 6CI with 6TZ about 50 miles and 6BY about 45 miles.

All these can be received in the daytime with any reasonable aerial without advancing the volume control (delayed AVC). 6AM Northern comes in at good entertainment level as do the Perth nationals. Perth is 140 miles by road. I can get 6PR, 6PM and 6KY, at tolerable strength and 6IX with 500 watts and a mast on top of Newspaper House and a counterpoise earth is just hearable.

All night it is bedlam until the Eastern States stations close. About three or four feet of wire as an aerial gives best results.

I hope this really starts something on MF receiving aerials. (L. G. Denham, WA).

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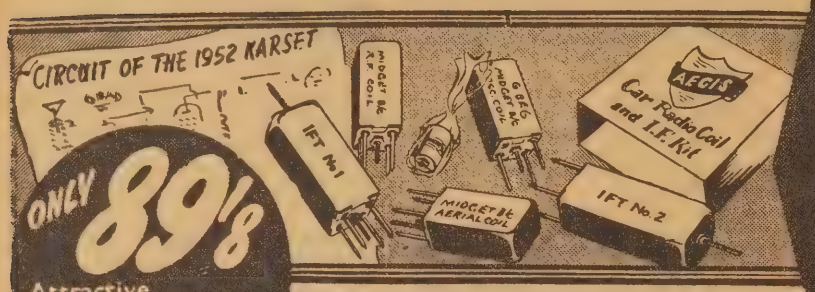

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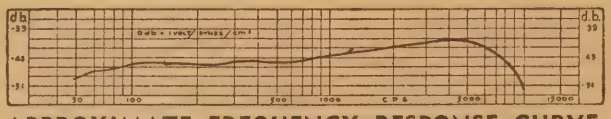

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batteries might only have a normal life on load of 50 hours, representing eight odd weekends at the suggested rate. During this time they would hardly dry out through old age. But the extension of their life to a possible 100 or 150 hours would represent a rather spectacular saving.

PRIVATE FUN

"D.S.", of Bathurst, is apparently having his own private fun with technical arguments. It is fun, provided you don't come to blows!

The answer to his question about using wax in power transformers could be answered very simply . . . "yes, because some designers like it".

In greater detail, wax has been used as an impregnant for electrical transformers for as long as we can remember—and even that isn't long enough. Its job has been to bind the assembly mechanically and to retard the action of moisture by "getting in first".

Normal procedure has been to dip the transformers into a bath of hot wax, allow it to displace the air from the windings and then to solidify.

But what do we mean by "wax"? Under the heading one can include a whole range of substances differing in origin, chemical makeup and electrical characteristics.

Because most waxes have a low melting point, they tend to run out of windings operating at high temperature. As a result, many transformer designers have swung over to electrical varnishes, which are made to penetrate the finished windings and are then baked hard.

But what do we mean by varnishes? Some have proved excellent in service, others have hardened and cracked, still others have turned out to be corrosive, even attacking the enamel on the winding wire.

WAX, VARNISH, PITCH

So you have two schools of thought. One sticks to its pet kinds of wax and recounts experiences with poor varnish. The other sticks to its pet kinds of varnish and recounts its unfortunate experiences with wax.

By way of variety, members of a third school, with recruits from the other two, are never happy until they have sealed the windings inside a metal can and then filled it with pitch.

But what kind of pitch? We give up!

"D.S." also wants to know about putting volume controls in the plate circuit of amplifiers. In some cases, we agree, it might be more convenient to do so, but we hardly ever do. Why not?

The reason usually advanced is that a control in such a position is more likely to become noisy, though this is hardly a complete explanation. Why should it?

The most obvious explanation I can think of is there is a potential gradient along a plate resistor, which might easily be as high as 50 or 100 volts DC. If one end of the grid coupling condenser is connected to the moving arm of the pot, and the other end is returned to ground through the grid resistor, then varying the pot. setting must vary the potential across the condenser.

In other words, a charging current will flow through the grid circuit and any discontinuity introduced by roughness in the potentiometer will be amplified and may appear as noise in the output.

The effect is normally absent from the grid circuit, unless there is some very unnatural condition present. Come to think of it, an unduly noisy pot. is often a pointer to a leaking coupling condenser.

In other words, D.S., the idea of having a plate circuit volume control is likely to magnify the problems of noise and it would only be successful if the pot. was a good one and there was only moderate gain to follow it. So much for that.

IT DID HELP

In the third letter, from L.G., there is more than meets the eye. To dispose of the easy part first, it is only necessary to mention that our reception at the office is normally marred by two things — a steel building which shuts out the signals, and the colossal mass of electrical equipment in the immediate vicinity.

This latter ranges from cars and trams in the street below, to countless motors and fans, electronic equipment, &c., and a whole street full of x-ray and diathermy equipment (Macquarie St. specialists being what they are).

With odd pieces of wire close to the building, it is good going even to hear all the local stations. To erect a roof-top aerial and lead-in that would pipe a country station into our test room was really something! It is not the absolute range that counts in a case like this but the comparative results.

To be compelled and able to listen all the while to distant signals commands my immediate pity and respect.

Now for this matter of aerial polarisation. It is all part of the general subject of propagation, which has promoted bigger and better arguments than any we are likely to start here.

For example, one can pick up that excellent handbook by F. E. Terman and read lengthy quotations about surface wave propagation. However, on the very page of the Radiotron Designers' Handbook quoted by L.G., there is a statement that the surface wave, as postuled by Zenneck and Sommerfield, does not exist!

TUT, TUT, TUT!

It adds the lament that the idea is still to be found in technical literature, to the confusion of studious readers.

While friends Terman, Christiansen and others are welcome to their little differences it doesn't relieve us of the responsibility of giving some sort of answer to L.G.

In the first place, it is apparently wrong to assume that waves radiated from a vertical aerial will arrive at the receiving point wholly vertical in their polarisation.

Because the transmitting and receiving aerials are both very close to ground (electrically speaking), the earth's surface has an effect on the wave front. It tends to produce a forward tilt which is equivalent to a horizontal vector component.

In addition to this, considerable local distortion of the field can occur. Just how much, can be seen easily enough by a search for signal null points with a loop stick. In some situations it varies markedly from one station to another.

In other words, there is a minor but definite horizontal component in the incoming signal field which can be utilised directly by horizontal portions of the aerial.

HARDLY PRACTICAL

Be that as it may, it does not alter the fact that the most efficient type of receiving aerial would be a vertical wire, naturally resonant at the frequency of the incoming signal. Unfortunately, this doesn't measure up to the usual requirement of hearing stations distributed over a wide frequency band. Nor is the idea of a tower hundreds of feet high very practical for listeners.

So, we diligent souls erect an aerial as high as possible and with a flat top about 30-50ft long, depending on the available space. The vertical component of the aerial picks up signal and feeds it by a direct connection to one end of the aerial primary winding.

The signal circuit is completed via the bottom end of the winding to ground, thence by capacitance between earth and the aerial flat top to the upper end of the vertical section.

In other words, we visualise the vertical section of the aerial as a generator, the primary of the coil as the load and the aerial flat-top/ground capacitance as part of the return circuit. That is why, quite apart from polarisation, the flat top has a bearing on coupling efficiency, signal input and so on.

If we admit that the signal field has a horizontal as well as a vertical component, then the aerial flat top must be conceded as being also a source of signal pickup. What the phase relationship would be, appears, at first glance, to be a matter of chance.

A SPECIAL CASE

The noise-reducing aerial is a special case. It must be assumed that the source of interference is concentrated in the vicinity of the receiver and, to shut it out, the entire down lead is rendered insensitive to signal pickup by shielding or transposition. This means that the only wire left to pick up signals is the horizontal portion—a fact which is not by any means peculiar to the Radio and Hobbies article. (Vide Terman, PMG literature and others.)

Presumably such systems work in the first instance because the incoming signal can induce current and voltage in the flat top. Further that the signal-to-ratio by so doing is better than it might be if the vertical section were enabled to pick up signal and the noise as well.

But this I admit—the system would be even better again if the active portion could be held vertically instead of horizontally.

But then, sky hooks are so confoundedly expensive!

Of course, you could run the transposed lead along the ground and take up aerial pickup wire straight up a distant pole. Trouble is the difficult types who insist that noise is close to the ground and vertically polarised!

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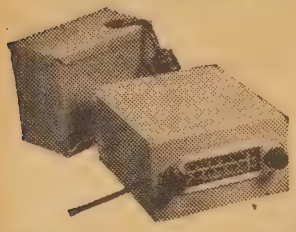

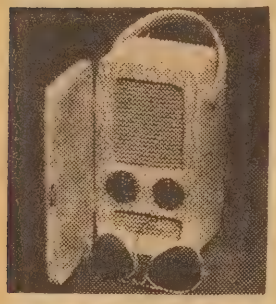

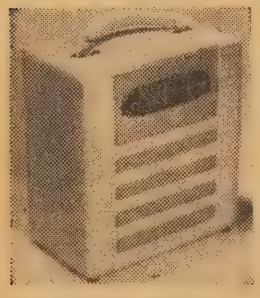

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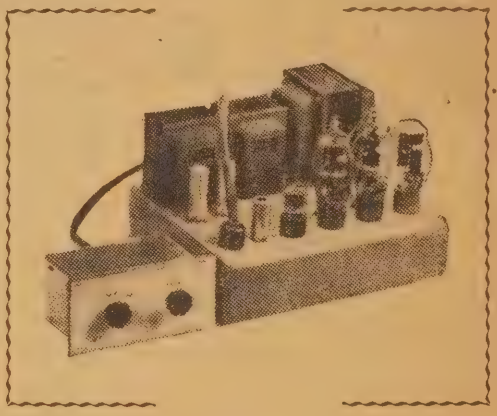

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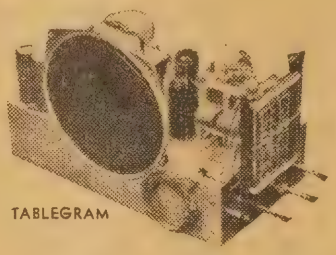

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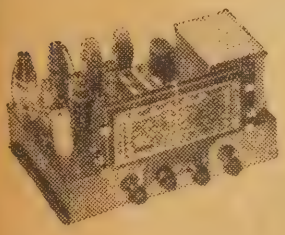

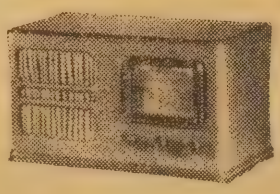

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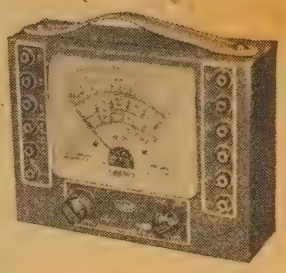

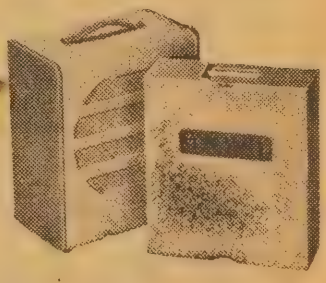

Pictures on right, top to bottom, are—MK1 Multimeter Kit, OK1 Oscillator Kit, 25 watt Amplifier, 10 watt Portable PA System.

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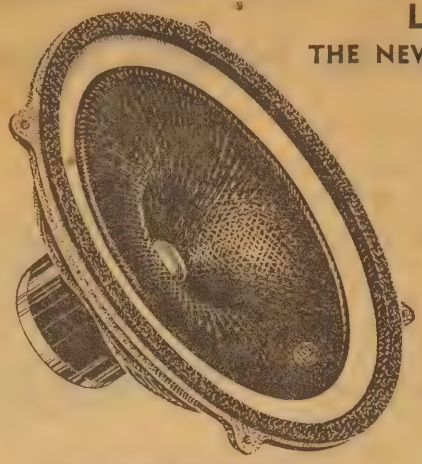

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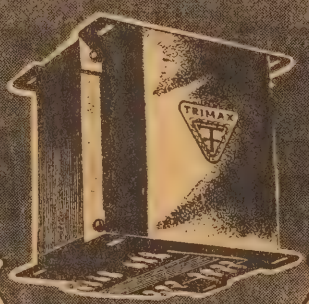

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FROM THE SERVICEMAN WHO TELLS

This month I have two very interesting stories to tell, both being a little out of the ordinary. One raises the point of vibrator circuit design and the other the question of so-called "earth" returns where sensitive microphone circuits are concerned. Both problems raise some very interesting points.

THE average city serviceman does not, as a rule, have a great deal to do with vibrators. When he does they are usually in a car radio and simply require that a component, usually the vibrator itself, be replaced with one of similar characteristics to put it back into satisfactory operation. The question of design seldom, if ever, arises.

However, design factors are important and a better appreciation of some of these can be very helpful when one is faced with some of the more tricky and less conventional vibrator problems. These are most likely to arise when one is called upon to assist a home constructor who is not quite sure of his ground, and may be further confused by lack of information regarding the exact values of the various components involved.

VIBRATOR PROBLEM

Such a situation occurred recently when I dropped in on my amateur friend for a quiet chat on matters electronic (and a cup of tea if there was one going) and found him bogged down in the problems of vibrator power supply design.

It seemed that some amateur field day activities were in the offing and he was endeavoring to produce some kind of a Dick Tracy set for the event. Actually it was really a pack set and a long way from the mythical wrist watch affair, but I gathered that my friend had spent so much time and effort packing everything into the smallest possible space that he felt as if he had actually produced such a device.

In an effort to scale down the power supply along with everything else, he had obtained a miniature vibrator transformer from somewhere and was hoping, in spite of the reduction in size, to still obtain reasonable efficiency. Unfortunately, he had been unable to obtain any information about the transformer other than the primary and secondary voltages, and such details as optimum buffer condenser size were completely lacking.

CURRENT DRAIN

My friend considered that he would probably be fairly close to the mark if he fitted standard value buffers for a start and then juggled the values one way or the other as seemed necessary to obtain the final value. A figure of .005 mfd was one which he seemed to remember in association with most vibrator circuits so he obtained a pair of these and connected one across each half of the secondary.

Then, with no load connected to the secondary, he proceeded to measure the no-load current in the primary, economy of battery drain being of considerable importance in a project of this kind. Although he had expected some reduction in efficiency due to the small transformer he was horrified to find that no-load current and reed driving current together amounted to over two and a half amps! It was a few minutes after this rather shattering discovery that I arrived and I naturally received the full force of his distress.

BUFFER SIZES

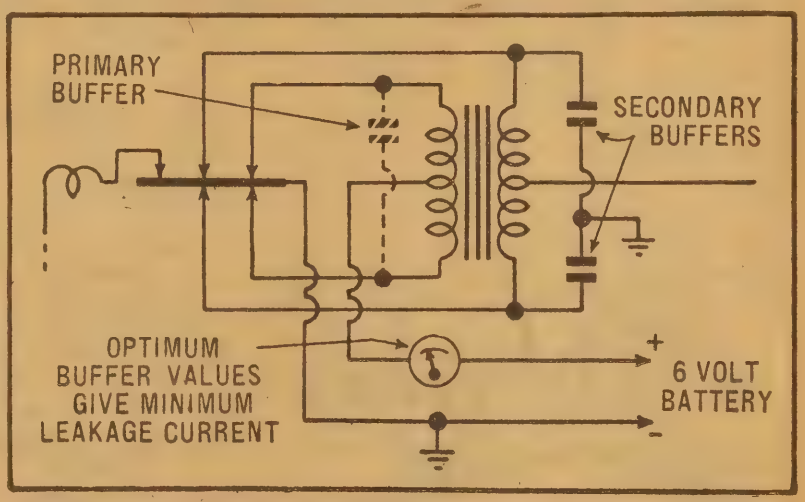
I was mainly concerned with the value of buffer condensers and whether they were, in fact, really the optimum value. When I raised this point my friend was inclined to doubt that it was important in terms of no-load current. On the other hand I was convinced that the true story would not be known until the optimum value had been found experimentally and that it was quite possible that the value now in use was a long way from optimum.

For a start I queried the value of .005 mfd, having an idea in the back of my mind that .01 was more usual in standard circuits. Since we did not seem to be able to reach agreement on this point my friend eventually located a transformer manufacturers catalogue which listed, among other characteristics, the recommended value of buffer condenser. Sure enough it was given as .005 mfd, but this value was specified as the total across the whole secondary winding and we both realised simultaneously that this important point had been overlooked.

To provide .005 mfd across the full secondary each buffer would have to be .01 mfd, the two being effectively connected in series. As it was, the total across the secondary was only .0025 mfd, exactly half of that required by a normal transformer.

In addition I suspected that the smaller transformer would have a lower inductance and would, as a result, require a large value of capacitance. A point not always fully appreciated is that the buffer condenser and the transformer inductance together form a tuned circuit, and that this should resonate at the frequency of the vibrator reed. Thus a transformer having a low inductance requires more capacitance in order to tune it to the same frequency.

However, for a start, we substituted .01 mfd buffers for the .005's and checked the no load current again. The effect was rather staggering to say the least. From a figure in excess of 2½ amps it had dropped to one amp, and of this, approximately 175 mA was the driving current for the reed.



Standard circuit of a vibrator supply which illustrates many of the points discussed in this article.

At this point, my friend, having recovered somewhat from his initial surprise that such a small modification could have such a marked effect, became quite keen to see how much further the current could be reduced by careful selection of the buffer values.

TRIAL AND ERROR

The next standard value was .02 mfd, making a total of .01 mfd across the full secondary. This reduced the current to 420 mA, which made my friend really happy, particularly as the reed driving current still had to be deducted and the actual no load current was therefore less than 250 mA.

It seemed unlikely that it could be reduced much below this point, considering the small size of the transformer, but by this time we

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were both determined to be quite sure that the optimum had been reached. The most convenient combination at this point was to add the .01's we had previously used to the .02's already in the circuit, making each buffer .03 mfd. However, this increased the current slightly from 420 mA to about 500 mA, indicating that we had overshot the mark.

Nevertheless, it was an interesting experiment, for it demonstrated the tuning effect quite markedly, suggesting that if one could have connected a variable condenser of suitable value across the circuit it would have been possible to tune it to an exact point as indicated by a dip in the primary current. As it was, we tried a few smaller values in place of the .01's but found that there was little to be gained.

OPTIMUM VALUES

It was possible to cause a further reduction, but it amounted to only a few milliamps and seemed to be hardly worthwhile when the additional bulk of the added condensers was taken into account. The general impression was that the response of the tuned circuit had a fairly flat top and that once a near optimum value was provided there was room for considerable variation before this flat top region was passed.

It also seemed that this flat top became much more pronounced when the secondary circuit was loaded, doubtless due to the damping of the tuned circuit, so that the buffer values were somewhat less critical under load conditions than when unloaded. Considering all these points, we decided that the value of .02 mfd for each buffer appeared to be a practical optimum.

At the same time it appears that the primary leakage, as measured under no load conditions, is as good an indication as any by which to adjust the buffer values, at least as a first step toward determining the optimum values.

It may well be that a final check with an oscilloscope will reveal that there are other reasons why the value should be varied slightly within the flat top region to produce the best results.

I left my friend with this thought (after having cadged the cup of tea I had in mind when I dropped in) and returned home to see what literature I could find on the subject to supplement the practical knowledge I had just acquired.

OPERATION ANALYSIS

The first point about which I was reminded when I commenced reading was that the buffer condenser really belongs across the transformer primary circuit, and that its main function is to store energy each time the primary contacts close and to discharge this into the primary winding during the brief period between the opening of one set of contacts and the closing of the other set. It is this brief period of "non-operation" which causes many of the problems associated with vibrator supplies.

The location of the buffer across the secondary is purely a matter of convenience and economics. The value of capacitance required to tune the primary of a 6-volt vibrator transformer is inconveniently large (electrically) and bulky (physically) to make it a reasonable proposition except in special cases. Essentially the same effect can be obtained, however, by connecting a small condenser across the secondary, when it will appear as a much larger value reflected across the primary.

This scheme works quite satisfactorily for all 6 volt systems and for 12 volt systems of moderate power, but has limitations where higher power or voltage is involved. Due to gas ionisation there is a greater tendency to arcing between the contacts at the higher voltages and the buffering must be completely effective to prevent damage to the contacts.

Due to the various losses in the transformer, the secondary buffers are not sufficiently effective to prevent arcing and most vibrator manufacturers recommend that at least a portion of the buffering capacity be in the primary circuit for 12 volt systems or higher. Fortunately, as the voltage is increased, the primary inductance is also increased, making possible smaller values of capacitance. This brings the required primary values down to a reasonable figure and something in the order of .5 mfd is all that is required at 32 volts.

It also seems that, ideally, allowance should be made for the ageing of the vibrator, its characteristics varying somewhat throughout its life, The two main causes of this are the erosion of the contacts and the gradual compression of the insulating spacers used between the springs.

Both effects increase the spacing between the contacts and thus increase the "non-operation" period. This in turn calls for an increase in the buffer capacity and the usual arrangement is to increase the value slightly above optimum for a new vibrator to ensure that it will still function correctly throughout its life.

32-VOLT SYSTEM

Speaking of 32-volt systems reminds me of a case related to me by a colleague. It seems that his organisation specialises in supplying kits to country home builders and, quite naturally, handles a fair number of these designed for 32-volt operation.

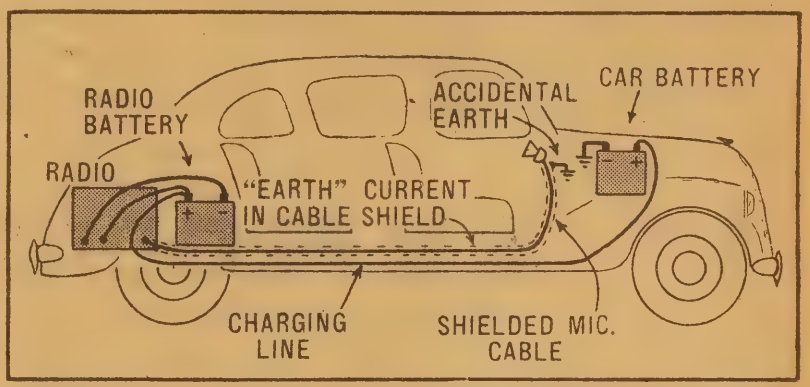
By always supplying the same make of transformer, vibrator, and similar components, together with buffers values, which had been shown on experimental models to be optimum, they had ensured that the home builders encountered a minimum of trouble in this direction.

At least that had been the case until recently. One morning the technical calm of the establishment had been shattered by a tearful letter from an up-country client, who was in dire distress with a 32-volt system.

It seemed that he had wired the components according to instructions, but that as soon as he had connected it to the power the vibrator had given forth horrible noises, suggesting a minor tornado inside. The spark produced when making or breaking the circuit to the battery also suggested that the current being consumed was very heavy, certainly much more than it should have been for a circuit of this kind.

The writer had apparently checked for all the normal causes of such symptoms, such as HT shorts and the like, without result, and had finally finished up disconnecting all components from the secondary side. Even under these conditions the effect was much the same and he then assumed that the transformer was faulty and had returned it for checking.

On receipt, my colleague had been commissioned to test the device and had set it up on the bench with a vibrator and buffer condensers, but without any other components on the secondary side of the transformer. The results obtained were very much as had been described by the owner and a measurement showed a leakage current of no less than 8 amps! It is little wonder that while making the tests one vibrator was completely ruined.



How the clash of "earthed" cables led to hum in a VHF mobile transmitter.

POSSIBLE DEVIATIONS

Thinking that the trouble could be a shorted turn in the transformer, the same set-up was tried on several new transformers of identical type taken from stock. The results were identical in each case. Finally, some semblance of reasonable operation was obtained by connecting a .5 mfd across the primary winding. This reduced the no-load current to only a few hundred milliamps, though there is no guarantee that this was the optimum value.

At the time of writing the matter is rather inconclusive, having been referred to the transformer manufacturer, and whose report is awaited. However, it seems fairly certain that some variation in the transformer characteristics, intentional or otherwise, had altered the inductance and hence the value of buffer required. Due to the critical nature of the high voltage vibrator circuit, a small deviation from the optimum caused a tremendous increase in leakage current.

All of which adds up to a very

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L.B. PRODUCTS PROFESSIONAL WIDE RANGE RECORDER

with these unique features:–

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10 watts (rated) push-pull output with 20 db inverse feedback.

12in speaker.

Input resistance:— 4 Megohms.

Input sensitivity:— 1½ mV. for full output.

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good case for the proper selection of buffer condensers and the fact that it is not always possible to take the values specified in a circuit as being optimum unless the characteristics of the transformer are known to be the same as the one used in the original circuit.

Even the frequency of the vibrator must be considered and, although these are normally identical in this respect, it is possible to obtain different frequency types for special applications. The accidental substitution of one of these could have serious consequences.

I seem to have spent my time this month becoming involved in other peoples' troubles, for no sooner had I finished with my amateur friend and his vibrator problems than I walked into another "curly" one.

COPPED THE LOT!

In this case I was paying one of my periodic visits to Radio and Hobbies and I was interested to notice one of the mobile radio cars in front of the building. Apparently it was being serviced because a member of the staff, wearing a dustcoat and a very worried look, was peering into the boot of the car and checking various connections and adjustments.

Purely by way of being sociable I passed the time of day and asked him how his radio was. It was a silly thing to do really, because he proceeded to tell me, I having happened upon the scene just when his emotions were getting the better of him. Hence, I copped the lot.

It seemed that this particular car was prone to severe hum in the transmitter which came and went for no apparent reason and was, therefore, as he put it, "rather difficult to track down". That, I considered, was a masterpiece of understatement because, in spite of all the curly intermittents I have battled with in my time, I found it difficult to imagine anything worse than an intermittent hum in a mobile VHF transmitter!

"Well," I said, "I must be going. Got to see a man about a dog. Been nice seeing you and I hope you find the trouble. Cheerio."

A VHF TRANSMITTER

But I might have known I was not going to get out of it that easy. It was pointed out that I was expected to at least be able to make some suggestions, even if I couldn't put my finger on the trouble right away. "You know, clever man, like you do in some of those articles you write." (Friendly sneer follows.)

I endeavored to ignore the sarcasm and pointed out that, much and all as I would like to help, VHF mobile transmitters were just not in my line. I explained that I would hardly know which end of the thing to look at first and that I would probably be more hindrance than help.

"Look, there's nothing to it," said my friend. "This section is the modulator and this is the RF end with the crystal oscillator, frequency multiplier stages, and the final here. This section is the receiver, in which we are not interested at the moment, and this is the transmitter power supply."

In spite of myself I realised that I was becoming interested and I made the fatal mistake of asking whether my friend thought the trouble was in the modulator or the RF end. This, of course, was his cue to launch forth with the full story of his investigation so far, and I realised that, whether I would be of any use or not, I was going to be "in" on the next stage of his work.

It seemed that he had already substituted a spare transmitter power supply and a spare transmitter, one at a time, in an effort to isolate the fault. These experiments had not been very conclusive, due to the intermittent nature of the fault, but the general impression was that the fault was in the associated car wiring rather than the actual units.

Weight was lent to this theory by the fact that the supposedly faulty transmitter and power supply had been tested on the bench and no trace of the trouble could be found under these conditions.

Quite naturally all this changing over of units and setting them up for bench tests had been a fairly lengthy process.

> AS you realize, our Serviceman relies on many authenticated cases for inclusion in these pages to cover a wide field of things that really happened. Have you got a case history which might help others? Write to the "Serviceman", care of Radio & Hobbies if you have, and tell him about it. Only requirement is that the experience you relate really did happen. We don't want fairy tales or tall stories.

Our friend had now reached the stage where he was replacing the original gear and hoping that it would continue to hum while he made some further tests. In particular, he wanted to render inoperative various parts of the modulator in an effort to determine whether the hum was originating in this part of the circuit, the associated microphone cable in the car, or the RF end of the transmitter.

Actually, he was very cunningly working up to the suggestion that I should make various adjustments to the transmitter while he observed the results at the base station, and before I fully realised what I was doing I was nodding in agreement to his various suggestions and instructions as to how I could help.

HUM CHECK

To be quite honest, I was now really entering into the spirit of the thing, and having got a general working knowledge of the system I was even able to make some suggestions myself as to the steps we might take. Finding that my friend did not dismiss these out of hand I began to think that perhaps there wasn't so much to this VHF business after all.

At this stage our friend left to check reception at the base station and I was instructed to wait for him to call me. Sure enough, after a few minutes I heard a carrier come on and then a voice instructing me to put the carrier on without modulation for about 10 seconds while he checked the hum level. When I had done this he replied that we were at least fortunate in that the hum was still evident, though still inclined to vary up and down.

The next step was to put the microphone preamplifier out of action, which was done quite simply by turning down the gain control, which apparently was located in the usual place between the preamplifier and the main amplifier. This was done with the transmitter on the air and was accompanied by a running commentary as to the various degrees of rotation involved.

When I had finished, the report from the base indicated that the hum had vanished as the control was turned down, reappearing when it was restored. Well, at least that was something, for it indicated that the trouble was either in the preamplifier stage or somewhere ahead of it. This eliminated the RF end and since the preamplifier stage had been pretty thoroughly tested on the bench, seemed to be throwing more and more suspicion on the car wiring.

However, we made a final check on the preamplifier by substituting a new, carefully tested, valve. The result was no different and my friend then suggested that an inspection of the wiring under the dash might reveal something.

UNDIGNIFIED POSITION!

Thus it was that I found myself flat on my back on the floor of the car, my legs on the front seat, and my head somewhere among the maze of wiring, levers and cables which constitutes the underside of a dashboard. Someone had rigged a trouble light to the car wiring and the press-to-talk microphone was resting on my chest. Thus entrenched, I was supposed to find the cause of the hum.

The procedure went something like this: "Car 5 to VH2AN. Is the hum still there? Over."

"VH2AN to Car 5. Yes the hum is still there. I suggest you move each of the leads in turn and test the various plug connections. Explain each move as you make it. Over."

"I am now exerting pressure on one of the plugs and moving it about in the socket. Any improvement? Over."

"No, no change. Try something else. Over."

"Well, there is some kind of patent connector in the main microphone lead. I take it that the outer metal casing is the equivalent of the braided shielding. This appears to be touching another shielded cable which is part of the speaker system of the regular car radio. Could that cause trouble? Over."

"There's one way to find out. Move it and see. Over."

"OK. I am moving it away—now. Over."

"That's it! That's cured it. Put it back on to make sure." (My friend's voice was quite excited now and I must confess that I was getting a bit of a kick out of the situation.)

"Right. Here goes. It's making contact now. Good contact, too. Probably better than it was before. How's that? Over."

"It's just about the most terrific hum I have ever heard. There's no doubt we've found it. I'll be right down. VH2AN out with Car 5."

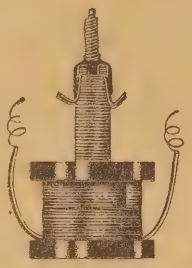
A few minutes later my friend handed me a roll of tape and I set about making sure that no such random connection could occur again. That done, I commenced the painful process of disentangling myself from the works and resuming a normal posture. I am convinced that the fellows who design motor cars have no more imagination than the fellows who design midget mantel sets.

(Continued on Page 97)

"Q-PLUS" Whistle-Filter

CHOKE—W.F.C.1.

Size—⅞" diam. x 1⅛" high (to chassis)



Inductance — 100 MH
Minimum— 95 MH
Maximum— 115 MH
(Adjusted by variable iron core)

Mounting — Push fit into 5/16" hole — speed nut type.

Winding Q at 10,000 Cps.—40.
Current Carrying Capacity DC 15 MA.

General Description and Remarks

Wound on iron dust bobbin which reduces stray fields. Turns may be easily removed or even added to obtain other values.

Designed primarily for Radio & Hobbies Whistle Filter circuits and tone control unit, etc. See October, 1952, Radio & Hobbies.

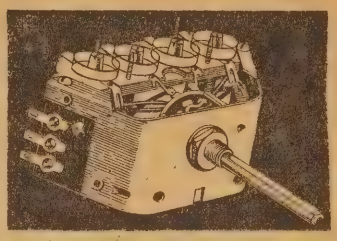
R. W. STEANE & CO. PTY. LTD., AUBURN, VIC.

"Q-PLUS" D.W. Brackets

PAGE 1

MINIATURE SINGLE STAGE B/C—S/W TUNING UNITS

SIZE
Height, 1⅝"
Width, 3½"
Depth, 2⅜"



TUNING RANGE
535—1630 K/CS
+
5.9—18 M/CS

Tuning Capacity—25—445 uufd. inc. strays.

CONVERTER TYPES

Four types are available and to obtain best results it is essential that the correct one be used.
DW4—6J8, 1A7, 6A8, etc.
DW6—1R5
DW5—ECH33/35, X61M, 6AE8, 6AN7
DW7—6BE6, 6SA7

MAIN FEATURES:

Carbonyl iron cores on all coils Sw and B/C.
All trimmers and adjustable cores accessible from one side.
4000 pf and 430 pf padder—condensers inbuilt—mica type.
Oak type wave change switch.
Narrowed neck construction to allow dial spindle and volume control to be closely fitted.
Polystyrene Short Wave formers, polythene covered windings for absolute minimum losses.
Litz wound broadcast coils.

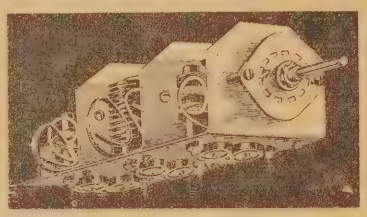
See page two for further information

"Q-PLUS" D.W.R. Brackets

PAGE 1

Miniature R.F. STAGE Tuning Units B/C—S.W.—GRAMO.

SIZE
Height, 2⅛"
Width, 2⅝"
Depth, 5⅜"



TUNING RANGE.
535—1630 Kcs
+
5.9—18 M/CS (16—50M—)
or
7.2—23 M/CS (13—42M—)

Tuning Capacity—25—445 uufd. Inc. strays.

CONVERTER TYPES

DW4—6J8, 6A8, 1A7, etc., B/C + 5.9—18 M/CS only.
DW5—6AN7, 6AE8, ECH33/35, X61M, etc.
DW6—1R5, B/C + 5.9—18 M/CS only.
DW7—6BE6, 6SA7.

MAIN FEATURES:

Carbonyl high frequency cores on all bands.
All trimmers and adjustable cores accessible from one side.
Built in mica padder condensers—4000 pf + 430 pf.
Oak type wave change switches.
Polystyrene short wave coils wound with polythene.
Covered wire for absolute minimum losses.
Litz wound broadcast coils.
3 sets switch contacts for dial light and Gramo switching B+ opening, etc.
DW6 type requires external bias source.

See page two for further information.

"Q-PLUS" D.W. & D.W.R. Brackets

PAGE 2

GRID CURRENT DETAILS.

If converter section is operating correctly, oscillator grid current should be approximately as follows:—

	SW HF end	FW LF end	BC HF end	BC LF end
DW4	.3 ma	.45 ma	.37 ma	.25 ma
DW5	.22 ma	.20 ma	.26 ma	.20 ma
DW6	.4 ma	.1 ma	.32 ma	.20 ma
DW7	.2 ma	.2 ma	.43 ma	.36 ma

ALIGNMENT

The alignment of these units is of extreme importance as other wise the full performance of the unit cannot possibly be obtained.

High gain I.F. transformers are desirable and it is assumed that these have been aligned. A Q Plus spot frequency alignment oscillator is a very useful article for this work and is available for only 75/- plus sales tax. Full instructions for I.F. alignment are included with that unit.

First see that dial calibration is designed to match the gang type and frequency range, particularly on S.W. band, then set dial pointer to the end of the calibrations when tuning condenser is in maximum and minimum positions respectively. BROADCAST Set Oscillator at 600 Kcs or thereabouts and move the dial until signal is heard — of course make sure that the switch contacts are in the B/C position. Each bracket is prealigned and no trouble should be encountered in this. Adjust B/C oscillator core until signal occurs when dial is at 600 Kcs. Next adjust B/C Aerial core for maximum output. Swing dial to 1600 Kcs and set generator to identical frequency. Rock dail until signal is heard, next adjust B/C oscillator trimmer and move dial until signal is maximum at 1600 Kcs Then adjust B/C Aerial trimmer for maximum output. Repeat low frequency alignment procedure and tidy up High Frequency end again. N.B. AVC should be shorted if set has same.

SHORT WAVE. Switch to S/W position on bracket. Set generator to 6.00 M/cs if 16-50 M or 7.5 M/CS if 13-42M and dial to similar setting. Adjust S.W. oscillator core for maximum signal. Swing dial and generator to 17 M/CS or 22 M/CS and use S/W oscillator trimmer to set dial position and S/W aerial trimmer to maximum output. Usually at the High Frequency end of the S/W band two spots will be found at which the generator will be heard — use the lower frequency one for alignment purposes.

In the case of the R.F. Brackets the procedure is identical with the addition of having the R.F. coil to align; this is done after the oscillator section has been aligned. It is necessary to rock the dial slowly around the alignment point as the trimmer is adjusted, as otherwise pulling effects will interfere with true alignment conditions. This is most prevalent at the H.F. end.

SEE PAGE 3 FOR FURTHER DETAILS.

A typical set of 4 pages from the NEW

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I.F. TRANS. CURVES

S.W. COIL DATA

ETC.

ETC.

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Dear Sir,

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M .. ..

Address .. ..

State .. ..

Here is the R & H 'Porta-Player", all ready to go. The cabinet is covered in two-tone leatherette with plastic piping. We used an engraved panel to back the controls but they could just as easily protrude through a piece of covered plywood to match the speaker fret.

THE R & H PORTA-PLAYER

Here is the complete "Porta-Player", housed in a two-tone, plastic-piped cabinet. Dimensions of the cabinet are given in the accompanying plans but ready-made units should be available by the time this article appears in print. Don't let the family see this picture if you don't want to build one!

THOUGH the idea of building a portable player appealed to us immediately, we asked quite a few people around the trade what they thought of it. Their reaction was unanimous . . . fine! But what about cabinets and chassis already in existence?

We checked on these and found any number of carrying-cases just large enough to house a playing deck. There were larger ones, too, big enough to take a complete record-changer.

TOO LARGE

When we looked for something designed to take an amplifier as well, it seemed that the only thing offering was quite a large affair capable of taking a whole range of decks, changers, amplifiers, tuners and so on. But it was too big, much too big, for what we had in mind!

It looked as though it was up to us.

The first job, of course, was to specify just what we were after.

To begin with, the unit had to be small, neat in appearance, and just as easy to carry as an acoustic portable phonograph. To have a big, bulky case, would defeat the whole object of the scheme.

Then it had to be simple to construct, able to play all modern records and as cheap as this kind of thing can be these days. After all, we've run plenty of designs for the man who likes the more complicated approach.

And performance? It had to be as good as we could make it, consistent with the other requirements. When you start off with an assumption of a small carrying-case, a small speaker and a baby amplifier, it's futile to rant about high power and thunderous bass. You do the best you can.

One can rest assured that the standard of reproduction is going to be away ahead of an acoustic phonograph, and at least equal to a good mantel set.

What is certainly just as important, a modern electric pickup will play all classes of record with hardly any wear. The acoustic head which will do likewise, has yet to be made!

Since we did not anticipate any special difficulty with the amplifier, first attention was given to the choice of playing deck and the requirements it would impose on cabinet design. And what an array of pickups, motors, decks and changers one can visualise!

It rapidly became obvious that a cabinet "universal" enough to house them all would have to be inches bigger all around. Motors hang in different positions, auto-stop gear protrudes this way and that, speed controls go here or there, and so on, ad lib.

In the face of this, we decided to break with our traditional policy and design the cabinet around one specific unit. As far as we can see, the best known unit currently available is the BSR deck, with "turnover" crystal pickup. This was duly selected and used as the basis of the design.

We discarded the idea of using any kind of record-changer, because we reckoned that the price would be out of proportion to the essential simplicity of the unit. Besides, the lid would need to be a lot deeper to contain the longer spindle and the record stack.

At the other extreme, a separate motor and pickup didn't appeal, firstly, because of the possible variety of units, and secondly, because these items are normally mounted rigidly to the motor board. This emphasises motor rumble and aggravates any tendency there may be to acoustic feedback from the speaker.

As it is, the BSR deck comes as a complete unit and is normally attached to the motor board by three bolts passing through spiral spring mounts. This "floats" the whole assembly clear of the cabinet work,

prevents motor rumble being radiated thereby and virtually eliminates the possibility of acoustic feedback between pickup and speaker.

This is a most important point in a compact design and may need to be duplicated if you are inclined to build up a portable player using other than the deck suggested. Needless to say, you will also have to give careful thought to the size of the cabinet, shape of the cut-out, position of the amplifier, and so on.

Some decks may require the speaker and amplifier to be placed in the reverse positions, but this should be simple enough to arrange.

PICK-UP TYPES

We have definitely assumed one thing at this stage—whatever brand of pickup you use, it must be a high output crystal type. Although we haven't got around to discussing the amplifier as yet, it can be assumed beforehand, that a simple amplifier won't have the necessary gain and compensation for a magnetic type.

If you have fixed ideas about using a magnetic pickup, or if you have one on hand that must be used, then you'll have to start thinking also about a more complicated amplifier. It's not impossible by any means, just harder!

Considering the speaker, we obviously had to choose a small one that could fit underneath the motor board. Obvious choice, it seemed, was one of the oval Rola 5in x 7in units. We found that, by tilting it back at about 30 degrees and letting the top protrude into a slot in the motor board, we would require little more than the minimum height necessary to clear the amplifier components.

SMALLER SIZE

The method of mounting makes the cabinet work a little more involved, but the saving in height is well worth while. We'll leave till a little later the detailed description of how to make and/or fit up the cabinet.

The amplifier did give us food for thought, notwithstanding its apparent simplicity. We wanted, if we could, to get away with one valve plus a rectifier — two in all.

An immediate possibility was a 6AB8, a European miniature containing a triode amplifier and pentode output section capable of delivering just over a watt of power. This valve would certainly give all the gain we wanted, but we weren't too happy about its limited power output.

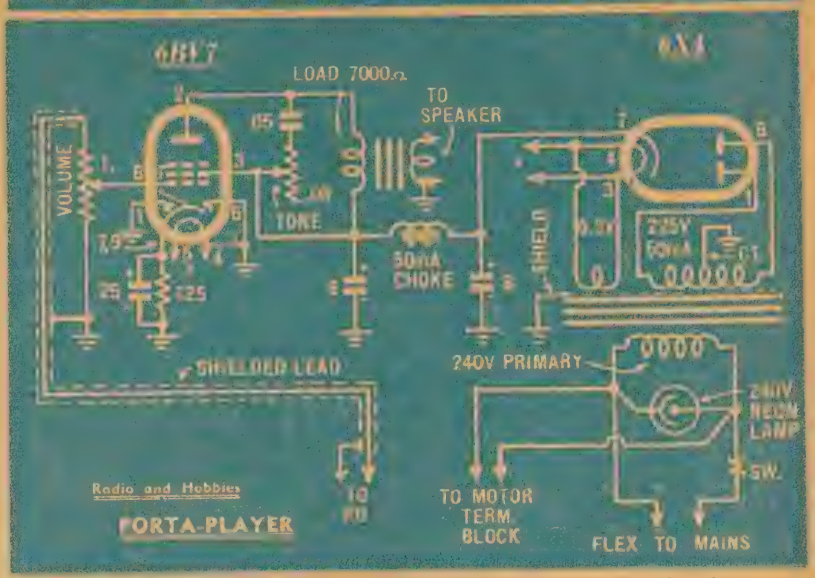
Conversely, we could get nearer 4 watts of power from one of the regular output pentodes, but could we drive one of these with a crystal pickup straight into a grid? We'd certainly done so in the old days of "rock crushers", 6V6's and 78 rpm records. What about the new pickups and microgroove records?

PLENTY OF OUTPUT

To cut a long story short, we tried the BSR pickup into the grid of a 6BV7 output pentode, the most sensitive of the current types. It wins by a mere whisker from the 6M5.

On 78 rpm records we found the valve running right up to overload on peaks. Microgrooves didn't drive it quite so hard, but they were still louder than you'd want in the home.

ONLY ONE VALVE AND RECTIFIER



The circuit is simplicity itself. Provided you use a high output crystal pickup, you will be running the amplifier most of the time with the volume cut back. For the not-so-skilled constructor, a complete wiring diagram appears elsewhere.

That would be our amplifier then—a 6BV7 output valve and a 6X4 to supply it with HT.

Having duly fixed the design, built it all up and put it together, we took it home and spent an evening playing all kinds of records. It didn't shake the floorboards with ponderous bass, but it did everything we expected of it.

You could take it into any room, dump it on a flat surface and have it playing records immediately. It sounded nice and clean, you could set the treble how you like with the tone control and there was plenty of volume for ordinary listening.

If you're the party type and you like to dance, you could do that, too. With the volume and treble turned well up, there's enough level on almost any dance recording to drive the output valve close to overload.

So much for what it will do. The next question is how to build it. First, the amplifier.

The original amplifier was built on a small chassis measuring approximately 4 3-8in square by 7-8in deep. Three of the sides were bent down, and, of these, two were provided with flanges to allow it to be bolted securely to the bottom of the cabinet.

The front edge was bent up to provide a support for the two potentiometers, as will be apparent from the photographs. When we ultimately draw the blueprint for the chassis manufacturers, we plan to add a fraction of an inch to the overall dimensions of the chassis to give a little more room, and to allow a switch-type potentiometer to be fitted. It was one of those small points overlooked in the initial layout.

ASSEMBLY

First job when you get the chassis is to mount the two valve sockets in their appropriate positions, facing them so that the blanks between 1-7 and pins 1-9 face outwards.

You can then mount the potentiometers, making sure to identify the 0.1 meg. and place it near the output valve. This will be wired as the tone control.

Before you attempt to mount the power transformer, try to identify

PARTS LIST

- 1 Chassis 4½in x 4½in x 7/8in deep with 1 3/8in fold-up along 4½in dimen.
- 1 power transformer 225V a side 50 mA, 6.3V 2A.
- 1 3-speed record player complete with crystal pickup.
- 1 50 mA filter choke
- 1 speaker transformer to suit 7000 ohm load (type E or equivalent)
- 1 oval speaker 5in by 7in
- 1 6BV7 valve, 1 6X4 valve 1 9-pin and 1 7-pin miniature sockets
- 1 1 meg. potentiometer (attached switch optional) 1 .05 meg. potentiometer, 1 125 ohm resistor. 2 8 mfd 525PV and 1 25 mfd 40PV electrolytic capacitors, 1 .05 mfd tubular capacitor, 1 240V .1w indicator neon lamp.

SUNDRIES

- 2 small knobs to tone with cabinet covering, 2 ¼in shaft couplings, approx. 1 ft of ¼in shaft, 1 4-tag and 1 2-tag mounting strips, rubber grommets, approx. 2ft of 2-core power flex, suitable length of 3-core power flex with 3-pin plug 1 engraved control panel, approx. ft of shielded hook-up wire, spaghetti, solder lugs, hook-up wire, materials for cabinet.

Ironcore Transformers Pty. Ltd.

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83 GT. BUCKINGHAM ST.
REDFERN
MX 1824

MELBOURNE
HIGSON LANE C.I.
Cen. 1503-1504-1949

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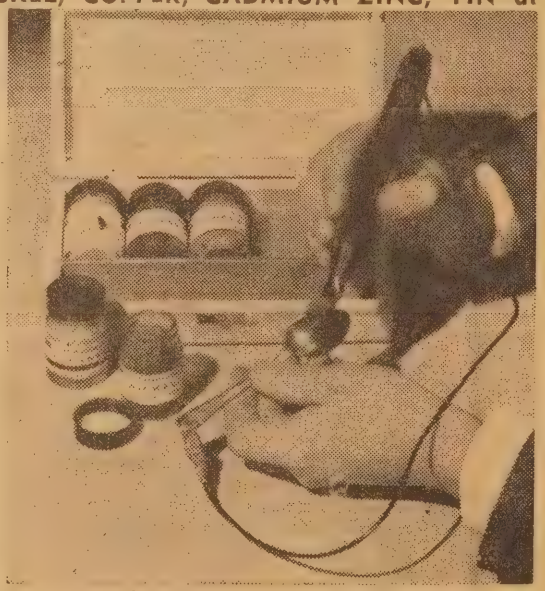

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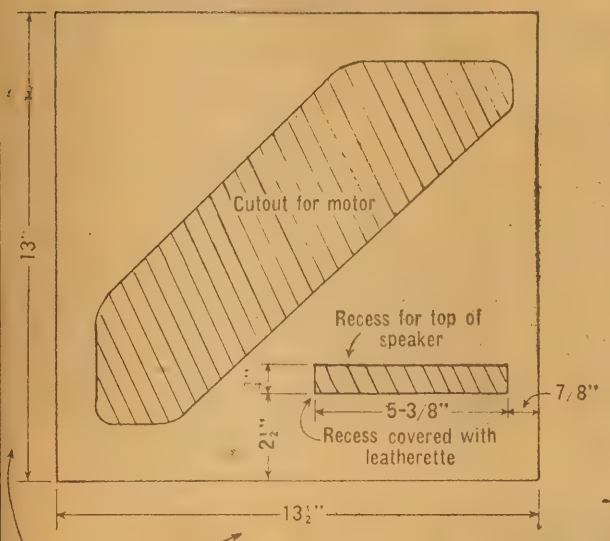
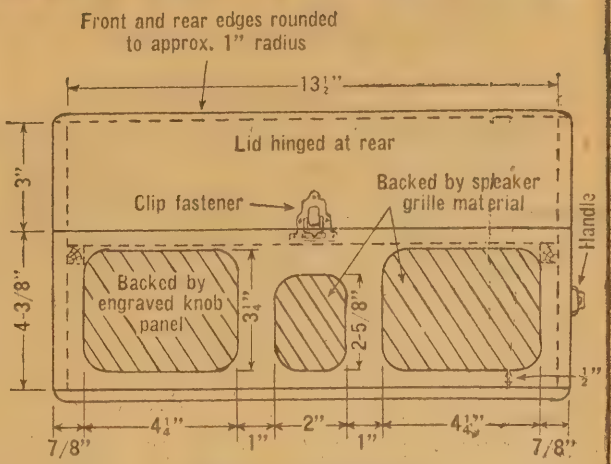
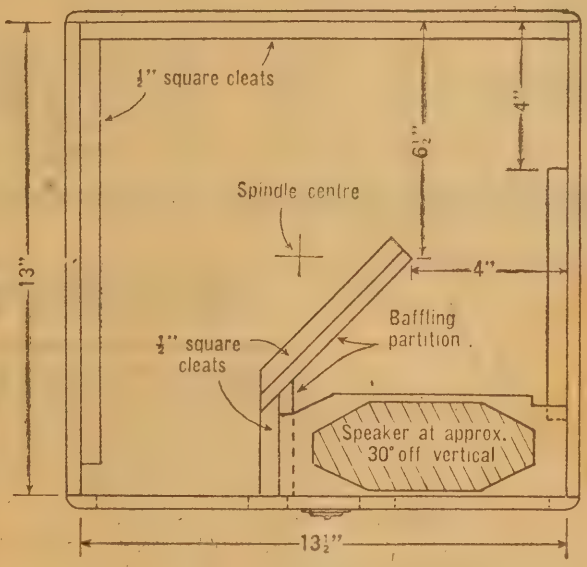
DETAILED PLANS FOR THE "PORTA-PLAYER" CABINET



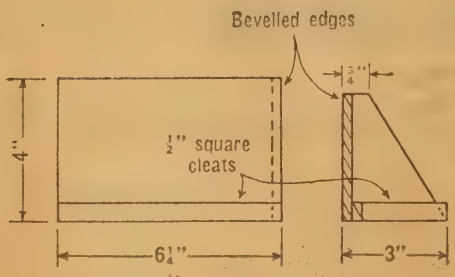
MOTOR BOARD



FRONT ELEVATION



PLAN VIEW WITH HINGED LID REMOVED



BAFFLING PARTITION

(Side elevation of each portion)

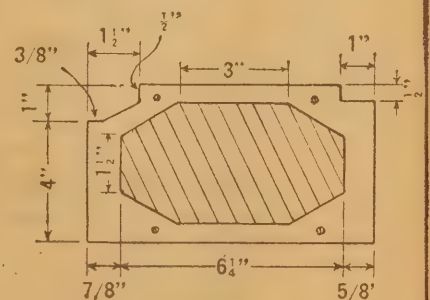
Major dimensions of cabinet are inside.
Top of lid and speaker baffle 3/16" ply.
All other timber 3/8" ply (except cleats).
Knobs placed at 2¼" centres and at height of 1-5/8" above inside bottom.
Bottom and one side of cabinet fitted with rubber feet.

CABINET DETAILS FOR

RADIO AND HOBBIES

PORTA-PLAYER

SCALE:- .2" = 1"



SPEAKER BAFFLE

(mounted approx. 30° off vertical)

These plans should enable homebuilders to "roll their own" cabinet for the "Porta-Player". It can be polished, lacquered or covered in leatherette, according to your fancy and skill. Most of the dimensions are given but, to make matters easier, the drawings are one-fifth full scale. All joints should be nailed and glued to withstand a reasonable amount of handling.

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NON-RESONANT SPEAKER ENCLOSURE
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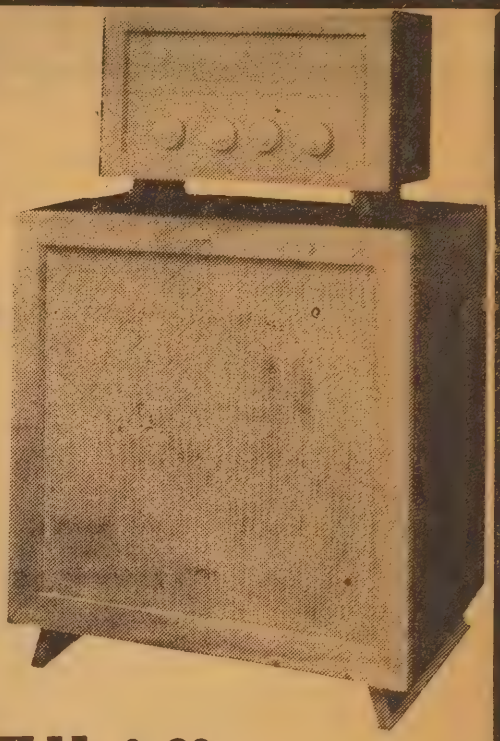

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Secondary 10 Watts continuous or 2A intermittent.

FEATURES:

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2. Fully enclosed.
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5. Very low temperature rise since the magnetising current is designed to a minimum.
6. Exceptionally low running cost.

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AVAILABLE IN STANDARD RANGE 285v aside @ 60mA to 385v aside @ 100mA types.

FEATURES:

1. Supplied with "Patent Applied For" adaptor plate suitable for 3" x 3½" mounting hole centres.
2. Removal of plate provides 2½" x 3½" hole centres.
3. Obviates servicemen having to redrill holes.

REFER TO STANDARD RANGE TABLE IN THIS ISSUE FOR TYPES

FERGUSON

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spect to the recommended grid leak the various leads. If you anticipate any difficulty about this, get your parts supplier to check over them with you, when you buy it.

The one we used was quite easy to work out. The two heavy leads were obviously the 6.3 volt heater winding and a single thin cotton-covered lead was the internal shield. This latter has to be earthed.

Two leads (one red, one black) coming out together were obviously the 240-volt primary, while a group of three leads from another part of the winding could only be the HT secondary. Of these (two yellow, one black), the black lead was the CT.

Not all transformers use the same color code, of course, but most of them use a similar logical grouping of the leads.

Needless to say, the transformer must be the right type and have the right electrical ratings.

POWER TRANSFORMER

The chassis is cut on the assumption that the transformer will occupy base area no larger than 2½in square and be no more than 3in high.

It should have the usual 240-volt primary, a 6.3-volt heater winding and a 225-volt per side HT secondary.

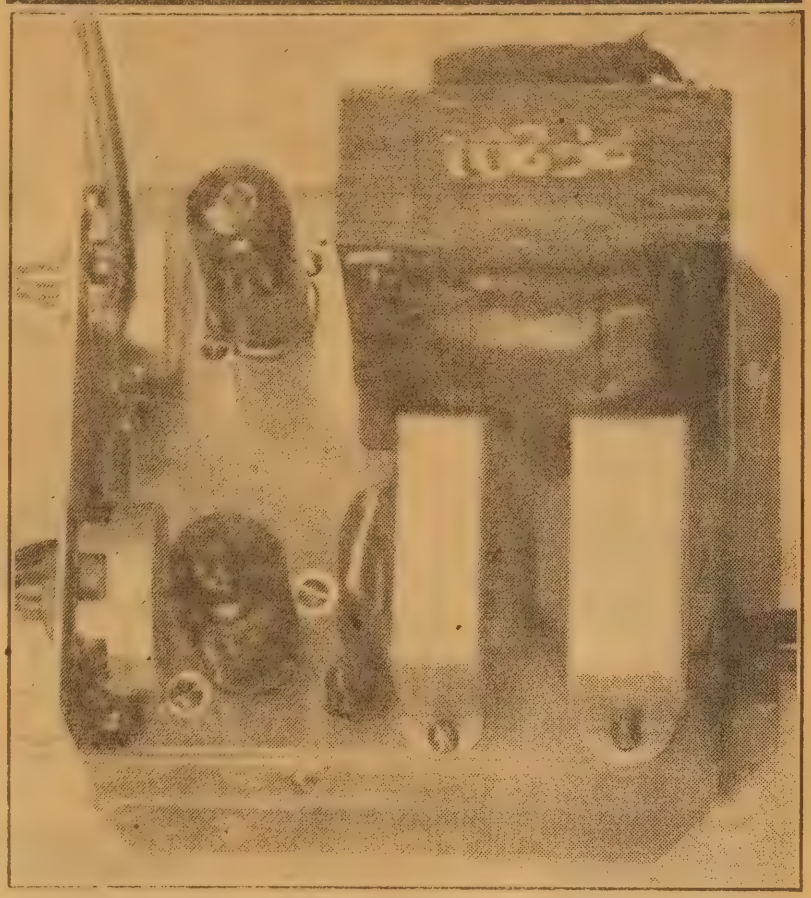
Having mounted the transformer, the two remaining components on top of the chassis are the speaker transformer and filter choke. To fit as intended, these should measure no more than 1¾in across the laminations, with small mounting lugs protruding beyond this.

The choke should be a 12-henry, 50-milliamp type, while the output transformer must be designed to match a 3.5 ohm voice coil to the 6BV7 output valve. Normal plate load of a 6BV7 is 7000 ohms, but a 5000-ohm transformer would do.

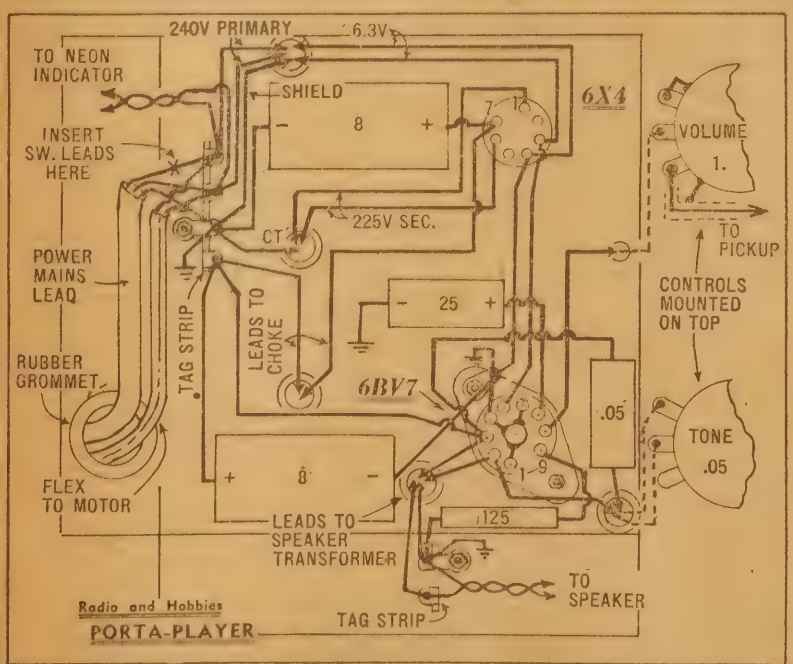
Beneath the chassis, we suggest you anchor a 4-tag strip under one of the mounting bolts of the choke. The earthed lug will serve as a handy return point for several leads, as shown in the diagram. Two of the insulated lugs can be used for the mains connection while the remaining lug forms a handy anchor point for the HT wiring.

Some care is necessary in wiring the mains leads. We suggest you clean and tin the two leads from the transformer and solder them into the rivet holes through the lugs.

TOP VIEW OF THE AMPLIFIER



A top view of the amplifier chassis, showing all components in position. The tone control is nearest the camera, with the 6BV7 behind it, then the output transformer and finally the choke. Be sure to get components of the right size, as mentioned in the article



This underneath wiring diagram should materially assist those who cannot follow the circuit. Don't forget to earth the centre spigot of the 6BV7 socket. It doesn't matter in the case of the rectifier.

POWER CONNECTIONS

The main power lead, a 3-yard length of 3-way flex, comes in through a large grommet at the rear of the chassis. Solder the red and the black wires to the insulated lugs which already connect to the transformer primary winding.

The green wire can be soldered to the earthed lug and, at the far end of the cord, will connect to the earthed pin of the power plug.

Two other pairs have to connect to the active mains lugs. One pair, which can easily be run in plastic twin light flex, goes out through the rear grommet and thence up to the motor. The other pair can run forward, under the front edge of the chassis and connect to the neon indicator light.

If you want to wire in an "off-on" switch, a slight change will be necessary in the wiring.

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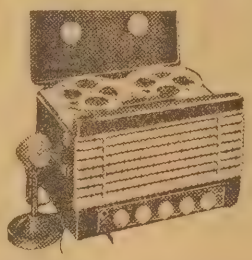

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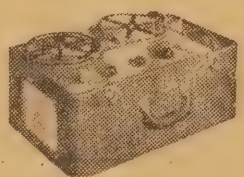

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The wiring diagram shows quite clearly the position of the few other wiring components and their connection into circuit. You will have to make certain, by the way, to get small sized 8 mfd electrolytics. The two we used measured 1 5-8in. long by 7 1-8in diameter, without their carboard jackets.

If you check each lead carefully as you put it in, and use the exact value of components specified, there should be no worry about improper operating voltages or such like. You can more or less take it for granted that the amplifier will work.

As we indicated earlier in the article, there is actually more to the design of the cabinet than there is to the amplifier.

INSIDE THE CABINET

The general view inside the cabinet tells most of the story. As you can see, the amplifier normally sits in the rear left-hand corner.

If the cabinet has a 3-8in bottom, the amplifier can simply be held down by wood screws. If it is only 3-16in ply, it will be necessary to use countersunk 1-8in whitworth screws coming up through the bottom of the case. Don't just drill two ugly holes, however.

Locate the position of the screws with a sharp point, pressed down through the ply but not actually breaking the leatherette covering. Turn the cabinet over and, with a sharp razor blade, cut three sides of a rectangle around the screw position. Lift up the small flap so created, drill and countersink the hole, insert the screw and bolt the chassis into place.

When the unit has finally been installed and tested, the flaps can be glued back over the screw heads.

As you can see by the photograph, the control spindles are extended forward by means of two ¼in couplings and two pieces of ¼in rod. Your radio supplier should be able to provide the couplings, while brass or steel rod can be obtained from hardware supply houses.

If the worst comes to the worst, you can buy a foot of ¼in copper pipe from your local garage. They supply it for petrol lines!

In the original "Porta-Player" we had the controls protruding through an engraved aluminium panel, which you can have duplicated if you want to. An alternative suggestion is to cover a small piece of ply with matching fret silk and drill holes for the control and indicator. The silk will not fray if it is properly glued to the board.

As we explained earlier, the speaker has been tilted back at an angle in order to conserve height.

A little bit of cutting and filing may be necessary to make everything fit but there should be no major difficulties involved.

Behind the speaker, we have provided a couple of small baffles which should come right up to the underside of the motor board and thus lead the back radiation of the speaker into the box. We had an idea originally of trying to create some form of loading horn behind the speaker but the large cutout required by the motor makes a sealed loading horn very difficult.

As it is, the rear radiation from the speaker cone is led into the rear corner of the cabinet and then disperses up past the motor cutout into the lid space. (There is a noticeable improvement in bass response with the lid closed.)

Having verified the position for the internal baffles, they can be glued permanently in place.

The speaker must be attached to its own baffle with four whitworth bolts and leads soldered to the voice coil before it is placed in position.

If carefully fitted, the speaker should sit quite firmly in place, resting naturally against the bottom of the cabinet and supported at the top by the inclined baffle plate and the shelf support.

We suggest that you tack a small triangular-shaped piece of ply alongside the inner edge of the baffle to seal the space between the front of the speaker and the fret.

When it comes to mounting the motor and pickup on the motor board, we suggest you be guided by the template which is normally supplied in the carton. When finally mounted, the whole assembly should be floating freely on its springs.

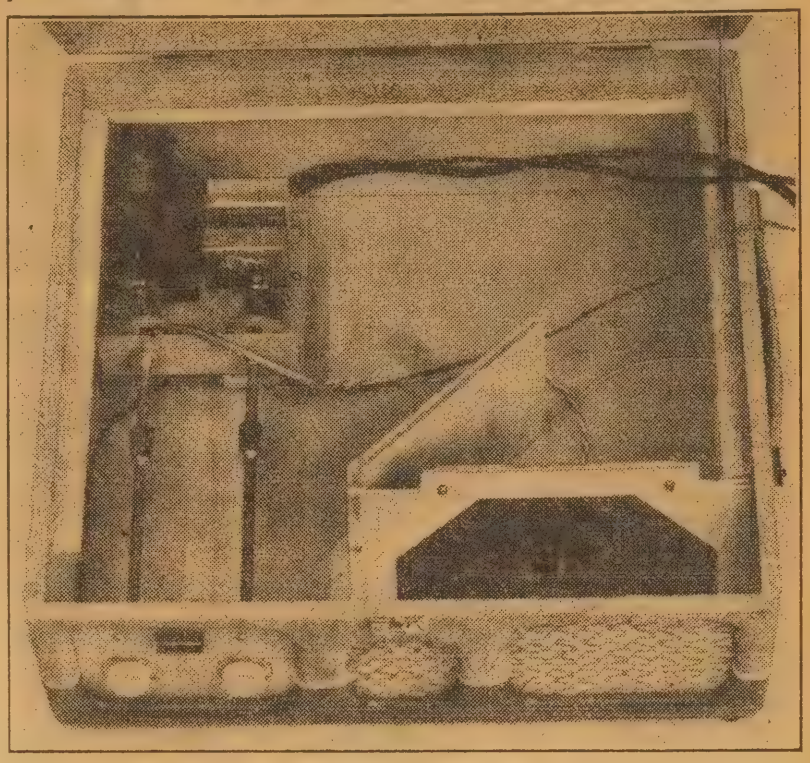
Two sets of connections have to be made to the motor. One is the 240-volt power connection, which should already be available from the amplifier. Instructions on where to connect the power leads are normally given with literature on the motor.

The second connection is the shielded lead from the pickup, which must be soldered to the volume control.

Unfortunately, there is not room to discuss at this stage the complete construction of the cabinet but the handyman should not have any great difficulty in duplicating the original from the plans given with the article.

The easy way, of course, is to buy a cabinet complete.

INSIDE VIEW OF PORTA-PLAYER



An inside plan view of the "Porta-Player" showing the amplifier in position and the extended control spindles passing to knobs on the front of the cabinet. Note also the speaker position and the baffle plates which control the rear radiation. A single screw at the left holds the baffle in place but a small cleat attached to the right front of the baffle could hold the other side by screwing into the side wall.

A MERRY CHRISTMAS

THOUGH perhaps a little early, we take the opportunity in this issue of extending to our readers the traditional greetings of the season—A Merry Christmas and a bright and prosperous New Year!

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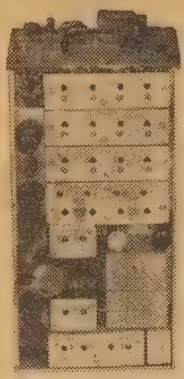

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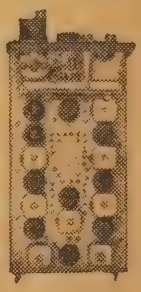

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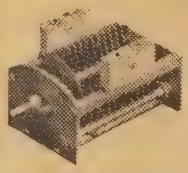

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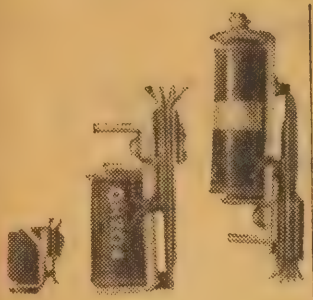

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All relays suitable for rewinding.

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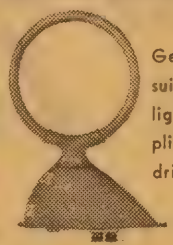

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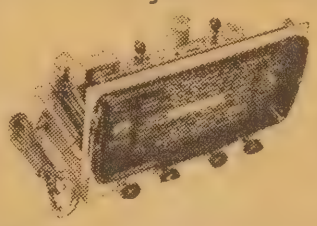
They have been discoloured by smoke but are in perfect working order.

Supplied complete with new valves (standard types), new 12in Jensen or Magnavox speakers, dial glass and escutcheon.



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10 ohm, 2½ amp; 25 ohm, 1 amp.
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Packing and Postage: 6d each. Per doz., NSW, 1/6; Q., T., V., 2/6; NT, SA, WA, 3/6.

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0—.5 amp. RF thermacouple 9/6
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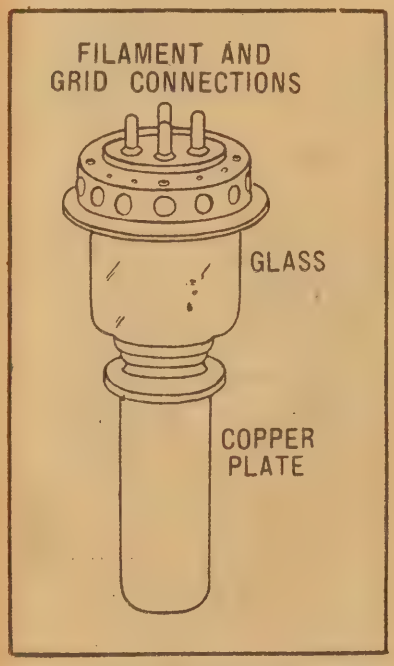
(All above are 2in flush mount.)
0-10mA DC English Turner 3in Round Flush Mounting 30/-
Postage Extra.

Here's your answer, Tom!

When radio valves have to be designed to handle large amounts of power, as in radio transmitters, a number of problems have to be given special consideration. These are concerned mainly with getting rid of the heat generated at the plate of the valve. It's probably something you haven't thought about much before, Tom, so you will find this article well worth reading.

TRANSMITTING valves aren't fundamentally any different from the ordinary receiving valves. They have the familiar cathode which emits electrons, the plate to which most of them are eventually attracted and the grid or grids which control their movement through the valve.

Special complex valves such as



A typical water cooled valve. The copper plate is encased in a water jacket.

those we discussed last month don't find application in transmitters except, perhaps, in the low power stages, where the small receiving types are just as suitable.

Diode valves capable of handling very large amounts of power are used in transmitters for rectifying the alternating current from the power mains to make it suitable for application to the plates of the amplifier valves. The mercury vapor type we told you about some months ago is almost invariably used, because it is much more efficient than the high vacuum rectifier.

You will remember from the characteristics curve that the voltage drop across the valve is constant at about 10 or 15 volts, regardless of the current flowing. The only thing likely to cause increased voltage drop across the valve is limited cathode emission. For high-powered rectifiers the filament power is increased in proportion.

There are some clever designs employed in some high-powered rectifiers to use the heat generated in the filament as efficiently as possible. For example, some valves employ a special shield around the filament to prevent wastage of heat by radiation.

The plate area, on the other hand, may have to be increased slightly to allow a greater amount of heat to be dissipated without causing an undue rise in temperature. This is usually one of the easiest requirements to satisfy, because the amount of power which has to be dissipated from the plate is relatively small.

The valves which cause the design engineer the real headache, Tom, are the large transmitting triodes, tetrodes and pentodes which are used in the final stages of high-powered transmitters.

HEAT WASTE

Despite all the advances which have been made in valve design, a not inconsiderable portion of the power which is supplied to the valve is wasted in the form of heat at the plate. The problem is to get rid of the heat before the temperature rises high enough to warp or melt the metal parts and glass of the valve.

With ordinary receiving valves, the air circulating naturally around the envelope is sufficient to keep the temperature down to a reasonable level.

Certainly, with modern miniature valves, the glass envelope gets very hot. In fact, you need not be alarmed if it gets far too hot to touch.

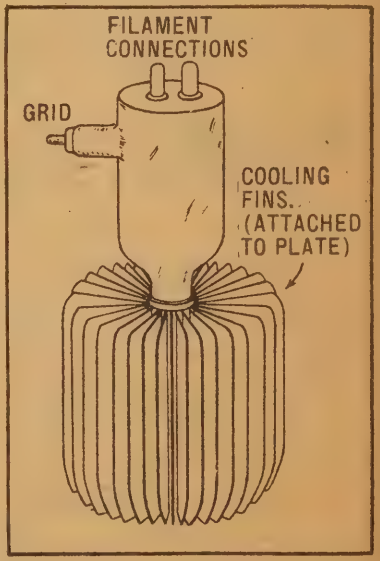
With one particular miniature output valve, the manufacturer states that the glass envelope is safe provided its temperature at the hottest point does not exceed 250 degrees centigrade. Water boils at 100 degrees centigrade, so you can see that the glass from which the envelope is made is able to stand up to a lot of hard usage.

The valve manufacturers do say, however, that the layout and design of the equipment should be such that a free circulation of air around the bulb is possible. If the circulation of air is stopped and power applied to the valve, the temperature may rise above the safe limit.

It is interesting to digress for a moment, Tom, and recall some of your school physics to arrive at an understanding of how the air cools the valve. You will remember that when air is heated it expands, and therefore occupies a greater space. When this happens, the hot air is lighter, for a given volume, than the cooler air around it. The result is that the hot air rises relative to the surrounding air, and more cool air comes in to take its place.

COOLING AIR FLOW

Thus, if you heat anything surrounded by air, there is a continual flow of air past it. You may have seen some of those fancy table lamps which use the flow of air past the



A large air cooled valve has fins attached to the plate and a flow of air instead of water to keep it cool.

globe to turn the shade around when the lamp is switched on. At the top of the lamp is a fan blade shaped something like a windmill. The air passing through the blade

causes it to turn, together with the attached shade.

With most of the valves we encounter in everyday practice the natural flow of air is sufficient. However, with valves handling large amounts of power, the natural flow of air is unable to keep the temperature down to a safe level. Designers do all they can to make the valve as efficient as possible so that little energy will be wasted as heat, but there is a limit.

Furthermore, it isn't always possible or desirable to have high-powered valves large in proportion to their power-handling capabilities. Large valves make the complete equipment larger and, in many circuits, especially those involving VHF radio waves, large valves contribute to inefficiency of the circuit by making it necessary to use long leads to connect them with associated components.

FAN PRECAUTION

In practice, Tom, the problem is solved by assisting the natural flow of the air by means of a fan. Sufficient air is directed at the parts of the valve which need to be cooled to keep them down to the required temperature.

The fan is usually driven by a small electric motor. Some power is required to drive the motor, of course, but this is usually small in comparison with the amount of power involved in operating the valve.

If the fan were to stop with full power applied to the valve, it is likely that a valve costing many pounds would be ruined in a short while. Provision is usually made, therefore, to remove the power if the fan circuit should fail. The fan could be operated from the same supply as the filament or, if this is not convenient, through a relay, the contacts of which are only closed when the power to the valve is switched on.

High-powered valves which require air cooling usually have some special provision in their construction for the cooling to be used to best advantage. The 4-125A or 4D21 is an example of one of the smaller valves requiring forced air cooling when used at full power.

With this particular valve the total amount of power to be dissipated from the plate and screen is about 100 watts. The base of the valve and the special socket made to go with it are designed so that air blown up from underneath the socket passes over the part of the glass which is most in need of cooling and then out through the holes in the metal surround of the base.

SIMPLE DEVICE

If there is only one of these valves requiring cooling, a small fan mounted under the socket is usually sufficient to keep the temperature down to the required value. The fan would simply consist of an electric motor with a set of blades mounted on the shaft something after the style of an ordinary domestic fan, but smaller in overall size.

If there is more than one valve, it is usaully more efficient to have one central fan and run pipes to direct the cooling air on the valves. A centrifugal fan is very much more efficient than the simple type and would be used in this and any other case where a substantial amount of cooling air is required.

Going on now to still larger valves, it is found that it is impractical to direct sufficient air at the glass envelope to keep it down to the required temperature and an entirely different technique has to be used. The plate is made in the form of a copper cylinder which is actually part of the envelope of the valve. The other part of the envelope is made from glass as before so that the grid and filament wires can be insulated.

This technique introduces serious manufacturing difficulties because the glass and copper have to be joined to give an air-tight seal around the full circumference of the plate. It is a major engineering problem to make the glass to copper seal withstand the pressure of the air over a wide range of temperatures. Fortunately, it has been done successfully and many of the high-powered transmitting valves are made in this way.

A still greater improvement in the cooling efficiency can be brought about by providing the outside of the plate with a set of cooling fins so that the heat to be taken away from the valve is distributed over as wide an area as possible. Strange as it may seem, Tom, the plate of the valve often looks like the cylinder of a motor-bike engine—and for the very same reason!

One example of a transmitting valve having cooling fins and requiring forced air cooling, which is familiar to technical people in large broadcasting stations, is the 891-R. It is capable of delivering 10,000 watts of radio frequency power and may dissipate power at the rate of 3500 watts at the plate.

REALLY HIGH POWER

You are not likely to want to use a valve as large as the 891-R in your one-valve receiver, Tom. As a matter of fact, there aren't such a great many radio stations in Australia that would use as large a valve as this in the output stages of the transmitter.

But, believe it or not, there are even larger valves used in some overseas radio transmitters. Type 9C21, for example, can dissipate 40,000 watts at the plate and deliver up to 160,000 watts of radio frequency power.

Even forced air cooling is not sufficient to dissipate the heat from the valve quickly enough to prevent the seals melting. The plate of the valve is a copper cylinder and part of the envelope, as before, but it has no cooling fins. Rather, it is completely immersed in a bath of water. All the time the valve is in operation the water is kept circulating by means of a pump.

To be a radioman in one of these stations you have to be a plumber as well!

The cooling water is introduced to the water jacket of the valve and taken away by means of pipes made from insulating material. As the plate potentials used with these valves amount to many thousands of volts, the pipes often have to be made quite long so that they will represent a high resistance. They may be made into the form of a coil in order to occupy as little space as possible.

The water itself must be reasonably pure, otherwise it will allow current to pass and thus waste some of the power. If pure water from the mains cannot be depended upon it is necessary to have a closed circuit system with a radiator to get rid of the heat. The radiator could be something like the radiator in a car, but greater precautions would have to be taken to ensure that the water did not become dirty.

Plenty of books have been written about transmitting valves. All we have done is to give you an outline so that you will appreciate some of the special problems. You may never want to set up a high-powered transmitting station, but still, it is interesting to know something about them.

Some of the special purpose valves used for industrial applications enter into the same category, but you may find it well worth while from the general knowlege point of view to know something about them.

With the general background of information about valves that we have given over the past few months you should be in a good position to understand an article on industrial valves, written by engineers of the Aerovox Corp., which is to appear in next month's issue (part three of a series on Industrial Electronics).

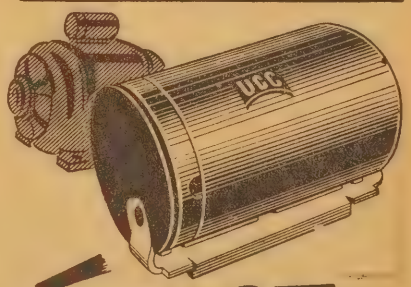
In the meantime, Tom, we have collected quite a bundle of your general queries to answer. So, starting with the next issue, we will deal with a number of questions of a general nature. There is room for all questions, so if there is something you would like to know about, write it down in the form of a query and post it to the Technical Editor.

LIKES TUNER

CONGRATULATIONS for a number of good articles published recently. Your push-pull Playmaster 2A3 amplifier should be very popular.

The broad-band tuner seems a fine design. Using an EF50 in the IF stage, mine has just sufficient sensitivity for this location, on the South Coast, about 50 miles from Sydney.

The "Let's Buy An Argument" series I find quite stimulating. — R.G. (Corrimal, NSW).



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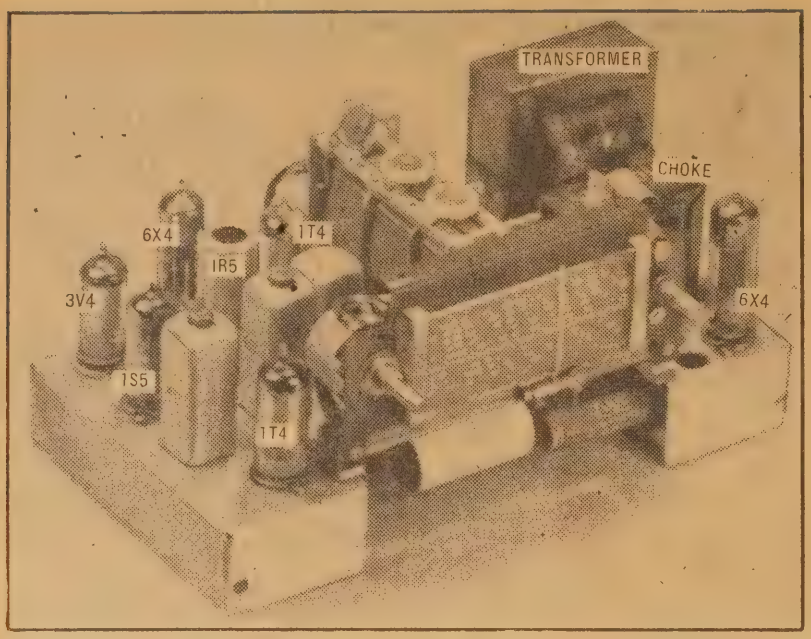


Here is a general view of the "Jubilee" chassis showing all the major components in position. The extra 6X4 rectifier is obvious as the tallest of the three valves along the rear edge. The function switch is mounted on the back of the chassis and operated through a cut-out in the cabinet.

DESIGN FOR A 3-WAY PORTABLE

Having published in recent issues a good deal on battery reactions, we round off the subject this month with a circuit design for a typical self-contained portable providing for operation from batteries, from the power mains and for reactivating the batteries during idle periods.

ARMED with this information, readers who like experimenting with new ideas can go ahead and build up a complete three-way portable in any form that appeals to them.

In fact, the design just about completes the line-up of modern portables.

There's the baby four-valve Carry Set described in October, 1949.

There's the straight five-valve Rambler portable featured in October, 1953.

There's the Rambler with AC and reactivate attachments described only last month.

There's the self-contained battery/AC Jubilee portable featured in December, 1951.

Now comes this latest three-way circuit.

Actually, for the sake of testing and presentation, the circuit was built into the Jubilee portable, for which, we understand, chassis and cabinets are still readily available.

BASED ON JUBILEE

We did this because the Jubilee portable already provides for a power supply and an "AC/battery" switch and the alterations to add reactivation are thus not very extensive.

Details of the necessary additions are given in the accompanying circuit and photographs.

Quite obviously the circuit could be used to adapt or modernise any other portable having the same valve line-up. It might also serve as a guide to readers wanting to design a multi-purpose portable of their own.

We must stress, however, that the design of a complete multi-purpose portable is not by any means a simple proposition. Apart from other things, the requisite series filament network has many ramifications.

INSTABILITY

The network must be designed initially so that all filaments pass their rated figures of current.

Compensating resistors must be added to bleed off excess current that will flow in parts of the network, due to the HT drain of valves at the positive end.

Precautions must be taken against instability, due to coupling through the filament network and, last but not least, due allowance must be made for the bias which appears on each grid by reason of the valve's position in the network.

Looking at the circuit for the Jubilee portable, or the Rambler for that matter, it will be noted that all filaments, including the two in the output valve, are connected in series. The network as a whole will thus draw 50 milliamps at 8.4 volts.

Additionally, however, three resistors are connected into the circuit to counter the effect of HT return current, as already mentioned.

Without some such protection, the filament of the 1S5 would, for example, have to carry a total of 62 milliamps — 50 from the filament supply and 12-odd milliamps from the HT return.

Three condensers can also be seen, connected at strategic points in the network and serving as a precaution against RF and audio instability.

Finally, all grids are returned to selected points to ensure that each valve operates with its correct initial bias. That is why the AVC network appears as a divider across the total filament circuit.

THE SWITCH

The original Jubilee portable used a two-pole two-position switch to change from battery to AC operation. It was a simple type occupying very little space under the chassis. At that time, naturally enough, we never imagined that any other type of switch would ever be required.

However, to provide for reactivation as well, it becomes necessary to use a three-position switch with additional poles. The only one we could think of which would be likely to fit under the Jubilee chassis was a Jabel type, four-pole, three-position. It will just fit, with nothing to spare.

Before you mount it in position, have a good look at the mechanism and the way it works. Identify the four moving contacts and the lugs around the edge which each contact serves.

Draw a small diagram, if you like, and try to arrange matters so that most of the vacant lugs will be down against the chassis where they are hard to get at, anyway.

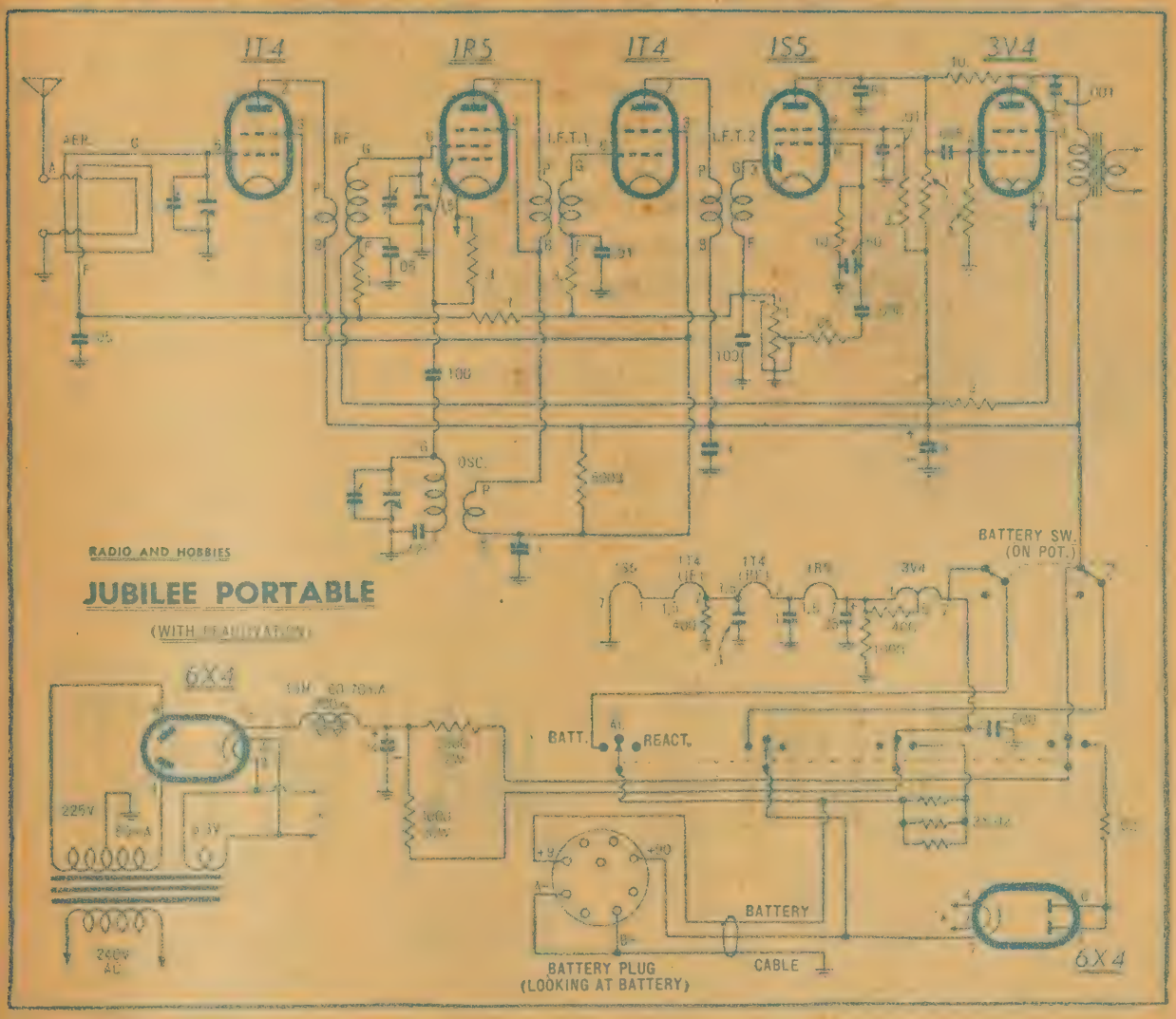
To get the switch in we had to shift one or two components and, thereafter, do some careful spotting with the iron to solder the various wires to it without melting the insulation off the others. Wiring a small multi-pole switch in a confined space isn't easy!

There was one other job we had to face, namely, the installation of a diode valve to protect the batteries against accidental discharge.

As we explained last month, it is possible with some circuit arrangements to discharge the batteries if the switch is left in the "Reactivate" position with no AC power applied.

To avoid this possibility, you remember, we wired a 6H6 in series

BATTERY OR AC OPERATION PLUS REACTIVATION



Here is a complete circuit for a self-contained Battery/AC/Reactivate portable. The receiver proper is almost identical with the standard "Jubilee" and "Rambler" portables, the AC power equipment being additional. It is immediately obvious that sets of this type are not simple.

with the HT charging circuit. It allows normal charging current to flow as long as its heater is energised, but, with no power applied, it becomes a complete open circuit.

RECTIFIER

While it might be possible to use a 6H6 in a larger set (they sell for about 3/6 ex-disposals), a valve of this size could only be accommodated on the "Jubilee" chassis by tying it on somewhere with a piece of string.

You could certainly do this if you wanted to, but we managed to find a spot just behind the IR5 converter, where a regular 6X4 rectifier could be installed. This involved cutting an extra hole in the chassis and moving one of the .25 mfd electrolytics to another position, as will be apparent if you compare the new photograph with the original layout.

There is actually nothing very critical about the choice of valves, or its physical position. All we need is a diode valve, or one that can be connected as a diode, with a separate cathode connection and capable of carrying 5 milliamps DC.

The idea of using a germanium type diode did occur to us, but apart from other ratings, they cannot be relied on to give complete protection. All of them have a finite back resistance and its value is likely to vary rather erratically with time, type and potential.

Then again, one could leave the diode out altogether and simply make a point of never leaving the function switch set to "Reactivate" without the AC power being applied. Unfortunately, however, the most careful among us suffer lapses of memory! We preferred to play safe and include the extra valve.

The function of the new components can be traced from the circuit.

In the "Battery" position of the function switch, the positive leads from the composite battery are connected through to the two poles of the regular "Off-on" switch on the potentiometer.

AC POSITION

In the "On" position, the two positive leads connect respectively to the filament network and the HT line.

In the "AC" position of the function switch, the batteries are completely isolated and, in point of fact, it is immaterial whether there are batteries in the set or not.

The filament and high tension circuits of the receiver are connected instead to the AC power supply, exactly as in the original "Jubilee" circuit and other sets of like design.

Provided you duplicate the original design — transformer, rectifier, choke and dropping resistor — the potential available for the filaments

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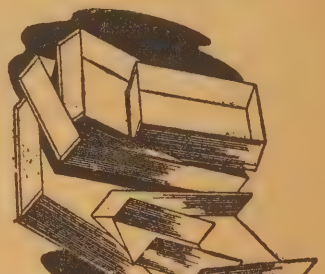

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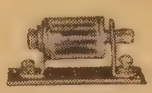

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should come out very close to the desired 8.0 volts.

Similarly, the HT tension voltage should be near enough to 90, although it can go a little higher without causing distress.

A small but important point is that the 500 mfd filament bypass is shown connected to the filament side of the function switch, not the power supply side. This is to ensure that the electrolytic is not subject to overload if the AC power is left on and the set operated inadvertently on batteries.

WON'T CHANGE

Neither is it possible by the same process, to charge the electrolytic to a high potential, then have it discharge through the filaments when the function switch is operated.

In the third position of the switch, "Reactivation", the receiver circuits are isolated from the batteries and power supply and, therefore, become inoperative. Energy is diverted instead from the power supply into the batteries.

The charging circuits are essentially the same as specified last month and produce a reverse current of just under five milliamps through the HT battery and just under 20 through the filament battery.

On this basis the batteries should be reactivated for a period equal to four times each period of use. Thus, if the set is operated on batteries for three hours in any one day, then the batteries can be left on charge overnight, or for a period of about 12 hours.

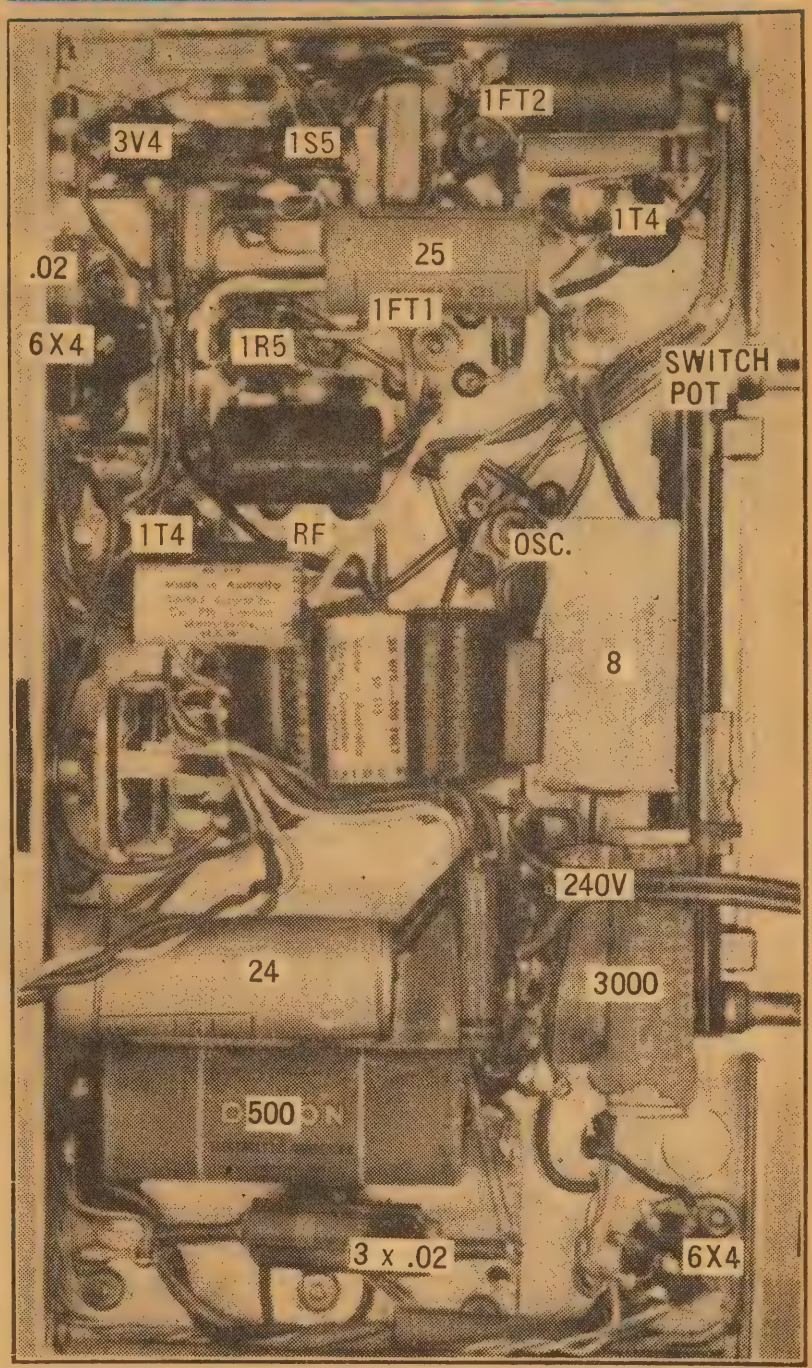
This is purely and simply a rule of thumb which should gain a most useful extension in battery life, without danger of excessive terminal voltage. Nothing drastic will happen if your assessment of operating time is a little out one way or another.

JUDGMENT NEEDED

However, as we pointed out last month, reactivation at desultory intervals, or after the battery has been virtually run to a standstill, will profit little.

At the other end of the scale, over-enthusiasm may give rise to excessive terminal voltage and accelerate drying out of the cells.

REVISED UNDERCHASSIS LAYOUT



Looking underneath the "Jubilee" portable chassis, with the extra valve and the new function switch in position. A couple of condensers have been shifted and a tag strip added at the power supply end to support the charging resistors.

The requirement is simply for a little bit of care.

Actually the whole proposition of reactivation appears to rest on this requirement. Though battery manufacturers will not guarantee any figure for "service life with reactivation" it is clear enough that a considerable increase in life can in fact be achieved under proper conditions.

To many this will appeal as "a wonderful idea". Others will simply prefer to buy extra batteries rather than "mess about". That is why there is no uniformity in commercial portables at the moment. Some won't have reactivation at any price, others feature it!

You, as an individual reader, must make up your mind and your reaction will incidentally guide us in the future. If you like the idea the circuit will give you all the information to build a three-way portable —irrespective of its shape and size.

If you don't like the idea, then leave your present portable strictly alone.

As mentioned elsewhere in the issue, we also used the Jubilee portable as a "guinea pig" for some tests on the new "loop-stick" aerial.

The Jubilee lends itself particularly well to the use of a loop-stick, because the shape of cabinet and the arrangement of the lids makes it difficult to use anything but a small loop of the conventional pattern. It is, in fact, the one point of criticism levelled at the design.

With the loop-stick in position, just inside the top edge of the cabinet, range was improved most markedly and we could listen to stations at good volume which were previously barely audible as carriers.

If you can manage to get hold of the necessary moulded rod, it is only a few minutes work to produce the finished loop-stick. You might even get it through for your holidays.

One word of warning: The moulded rods are hard, but rather brittle. Don't drop them on a hard floor or try to rivet clamps around them using a hammer!

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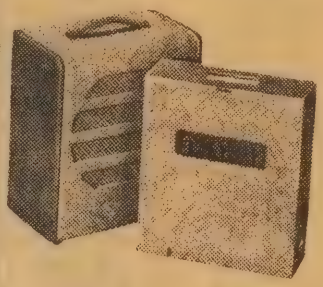

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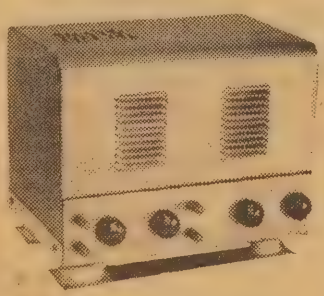

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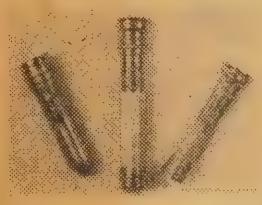

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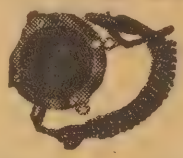

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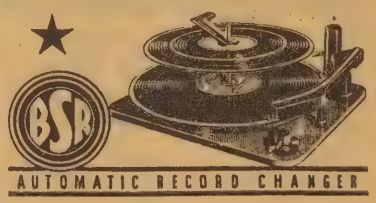

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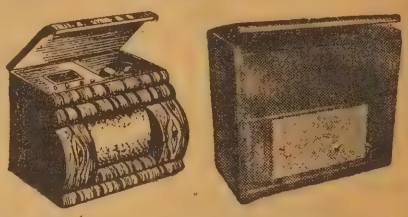

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TRANSMITTER BIAS SUPPLIES

There is a lot more to biasing a transmitter than connecting a resistor between the control grid and earth. This article by Aerovox Engineers analyses grid, cathode and external bias arrangements as applied to various types of amplifier.

PROPER operation of the audio and radio-frequency stages of a transmitter requires that certain recommended values of DC bias voltage be applied to each tube grid. This is true of class A, class B or class C operation.

Thus, when a transmitter RF amplifier is operating efficiently, plate current flows in pulses over only a portion of each cycle of RF exciting voltage. The peak value of these pulses is several times as large as the average DC value indicated by a plate-circuit milliammeter.

But the length of each pulse is determined largely by the magnitude of the grid bias voltage.

Bias requirements vary with each application of tubes in a transmitter. The bias voltage for doublers and other frequency multipliers, for example, must be maintained quite high, far beyond the value required, for normal plate current cut-off.

Final RF amplifiers and AF modulators, on the other hand, require grid voltages between cut-off, or slightly lower, to a little more than twice cut-off.

BIAS FOR CLASS B

Bias for class-B audio tubes must be supplied by a low-resistance source of extremely good regulation. This calls for batteries or a line-operated power supply preferably incorporating a voltage-regulation circuit.

Conversely a poorly-regulated supply is desirable for class-C telephony, since linear operation (and consequent good audio quality) requires that the value of grid bias voltage change with the plate-circuit modulation.

Bias requirements for other types of stage differ in still other respects, as will be pointed out later in the article. The final choice of a bias system, or combination of systems, will be influenced by both efficiency and economy.

It was once common practice to use batteries for transmitted biasing. Modern design, however, dictates AC-operated bias supplies or some form of automatic device. A description of these modern systems follows.

GRID LEAK BIAS

One of the simplest methods of obtaining grid bias voltage is by means of a grid leak resistance. This resistor is connected between the control grid and ground as shown in figure 1.

On positive half-cycles of excitation the grid acts as a diode plate and attracts electrons from the cathode.

This "grid current" produces a voltage drop across the resistor, the grid end of the latter assuming negative polarity. This voltage is effective at the grid as a negative bias.

The radio-frequency chokes shown in the circuits in figure 1 prevent the excitation power from flowing through the grid-resistor. The capacitor shunting each grid leak presents a low-impedance path to any RF energy that might succeed in passing through the choke.

In practice, it is often possible to omit the choke and the bypass condenser on the assumption that the grid resistor will be high enough in value not to load the driving circuit seriously and thus involve loss of power. However, each case must be considered on its merits.

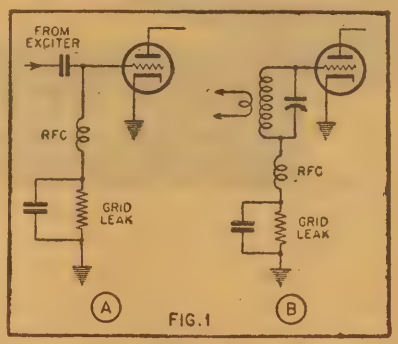

FIG.1

Where a meter is used to measure grid current it is normally connected in series with the "earthy" end of the grid resistor and suitably bypassed.

Grid-leak bias is somewhat limited in application. It cannot be used successfully, for example, with linear class-B RF amplifiers, class-B or class-AB AF amplifiers, or grid-modulated Class-C stages, since, in each of these amplifiers, the average grid current is continually changing and the bias voltage developed by the resistor would vary in unison.

However, where grid-leak bias is useable, it may be applied very simply to the circuit. The value of grid leak resistance for a given bias voltage may be determined from the following formula:

$$(1) \qquad R = \frac{1000\ E_g}{I_g}$$

R = Value of the grid leak (ohms)
E_g = Desired grid voltage (volts)
I_g = Required grid current (milliamperes)

The power dissipated in this resistor is:

$$(2) \qquad P = .000001\ I_g^2\ R_g$$

P = Power developed (watts)
R_g = Grid leak value (ohms)
I_g = D.C. grid current (milliamperes)

For two tubes (either push-pull or parallel connection) the grid current would be double, therefore the grid leak resistance would only be half the value obtained by means of formula (1). Similarly, the power value obtained with formula (2) would be double that with one tube.

When the proper value of grid bias for a triode is not known, but other characteristics are known, some idea of the grid leak value may be determined in terms of the plate voltage and amplification factor, thus:

$$(3) \qquad R_g = \frac{1000\ E_p}{\mu I_g} \text{ for Cut-off}$$

R_g = Value of the grid leak resistance (ohms)
E_p = Triode plate voltage (volts)
μ = Triode amplification factor (micromhos)
I_g = Recommended triode grid current (milliamperes)

Note that this value is for cut-off bias, whereas the class-C operating bias is likely to be at least double this figure. For a typical class-C stage, the grid resistor will need to be approximately three times the value as calculated above.

Grid-leak bias is not an entirely "safe" supply for RF power amplifiers. In all tubes except those designed specifically for zero-bias class-B AF operation, plate current will rise rapidly to a dangerous value in a grid leak-biased amplifier if the excitation is interrupted.

Except for some tantalum-plate tubes, which are able to withstand plate-current overloads more effectively than other types, such plate-current excusions will damage the tube or shorten its life.

SUPPLEMENTARY BIAS

This deficiency of grid-leak bias may be offset in one of two ways: (1) By employing a reasonable amount of fixed bias (battery or line-operated power pack) in series with the grid leak to hold the plate current to a safe value in the event of excitation failure, or (2) by including a safety device (such as a fuse or circuit breaker) in the plate supply.

The advantages of grid leak bias, including its simplicity and economy, are sufficiently attractive in some RF amplifier applications, to warrant inclusion in the circuit of some such safety device. More will be said of this later.

Since the RF excitation develops the bias by the grid leak method, the RF exciter must be able to supply the power consumed in the grid circuit.

The magnitude of the required power may be determined approximately by multiplying the grid voltage by the recommended grid current in amperes. The figure obtained will be the actual DC watts and does not take into account other losses appearing in the coupling circuit, which must likewise be supplied by the driver.

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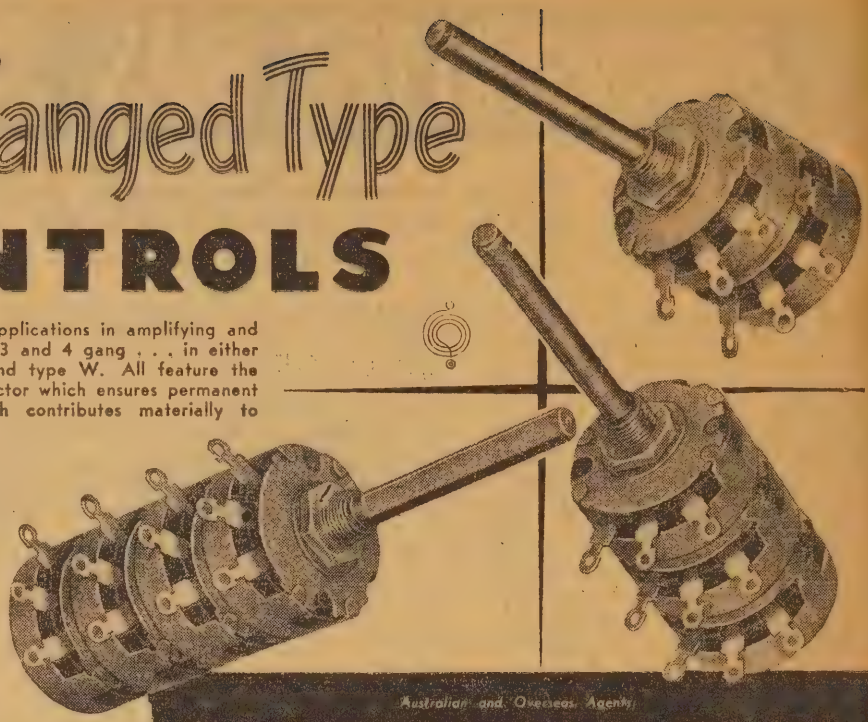

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896-9	8000 10,000	2, 3.7, 8, 12.5, 15	1	30-15,000	15	PP 6V6G's A OR AB1 TO VC	62/6
897-9	8000 10,000	100, 125, 166, 250, 500	1	30-15,000	15	PP 6V6G's A OR AB1 TO LINE	62/6
763-9	3000, 5000	2, 3.7, 8, 12.5, 15	1	40-20,000	15	PP 2A3's A OR AB1 TO VC	62/6
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As mentioned earlier, the poor grid-bias voltage regulation desired for linearity in class-C radio-telephony may be obtained easily with a grid leak, since bias secured by this method changes with modulation in the plate circuit.

Cathode bias, familiar in receiver practice, is another simple idea that finds use in transmitter circuits. This type, known also as "automatic" bias, utilises the familiar resistor in series between the tube cathode and ground.

The total steady plate and screen currents flow through this resistor, and the voltage drop across the resistor is applied to the grid as negative bias.

The method of connecting a cathode resistor into transmitter tube circuits is shown in figure 2.

CATHODE BIAS

It is readily seen that the value of bias voltage will depend upon the cathode current and will vary with it.

Cathode bias is therefore not generally useable in stages in which the DC plate current undergoes large fluctuations in the course of normal operation.

Cathode bias may be used with class-B RF amplifiers, but not with class-B audio amplifiers for the reason just given. In class-B RF service, the resistor must be bypassed adequately for radio frequencies and for audio frequencies as well, when the amplifier is used in radiotelephony.

The cathode bypass capacitor provides a low-impedance path for the AC component of plate current which otherwise would vary the bias voltage.

AUDIO BYPASS

If the audio bypass is omitted from the circuit or if its capacitance is too low, degeneration will take place. The cathode bypass capacitance is normally chosen to have negligible reactance at the lowest operating frequency.

Occasionally, degeneration is desired in an audio circuit to reduce distortion, although it reduces gain at the same time. In this case, the bypass capacitor is omitted.

The cathode resistor in a radio frequency stage must always be bypassed for RF, however, to prevent degeneration at the carrier frequency.

Since the total cathode current flowing through the tube and cathode resistor in series, produces the voltage drop, the value of this drop must be allowed for when designing plate power supply for a cathode-biased stage.

DISADVANTAGES

This is necessary because the effective plate-cathode voltage is reduced by the amount of the drop across the cathode resistor. In order to obtain any given plate voltage, it is necessary therefore to design the plate power supply to deliver the desired plate voltage plus the cathode-resistor drop (grid voltage).

This requirement frequently calls for an unreasonably large power supply for a small transmitter. This among other reasons has lessened the popularity of cathode bias in transmitters.

Some transmitter power stages utilise a small amount of cathode bias as safety voltage in conjunction with grid leak bias. This has proven quite successful; only about half of the required grid voltage is developed by the cathode resistor, the other half being developed across the grid leak.

The required value for any cathode resistance may be determined from Ohm's Law:

$$(4) \qquad R_k = \frac{1000\ E_g}{I_k}$$

R_k = Resistance of the cathode resistor (ohms)
E_g = Desired d.c. grid voltage (volts)
I_k = Total cathode current in *milliamperes*. (For triodes, plate current only; for tetrodes, plate and screen current; for pentodes with externally-biased suppressor grids, plate, screen and suppressor currents).

The power developed in a cathode resistor is:

$$(5) \qquad P = .000001\ I_k^2\ R_k$$

P = Power developed (watts)
I_k = Total cathode current (milliamperes)
R_k = Cathode resistance (ohms)

If two tubes are connected in parallel or push-pull and the bias for both obtained from a common cathode resistor, the cathode current will be doubled and the value of resistance obtained by means of formula (4) will be one-half the value for one tube.

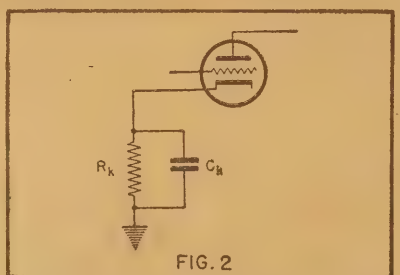

FIG. 2

Similarly, the power value obtained with formula (5) will be twice the value for one tube.

In RF amplifiers, the grid is driven positive. Grid current accordingly flows through the cathode resistor in the same direction as the screen and plate currents, and should be added to the latter when using formula (4).

EXTERNAL BIAS

Coming to external bias sources, rectified and filtered AC supplies have almost entirely supplanted dry and storage batteries for fixed bias in modern transmitters. They are likewise replacing grid-bias motor-generator sets.

Line-operated supplies are noiseless in operation, require no periodic replacements, except perhaps tubes, and do not generally present problems of high initial cost.

The design of an AC-operated bias supply differs somewhat from that of the more familiar plate power supply in several particulars:

(1) The bias supply, for example, furnishes no power to the amplifier to which it is connected.

(2) It should preferably employ full-wave rectification in order to prevent accidental modulation of the amplifier grid.

(3) The value of the bleeder resistance must be held within limits advisable for proper operation of the biased amplifier.

(4) The bias supply is a "positive-grounded" power unit.

For class-B audio, class-B RF, class-C telegraphy, and grid-modulated class-C telephony, the grid voltage supply unit must be well regulated. Voltage delivered to class-B AF grids should be within 5 pc of the value recommended by the tube manufacturer.

Class-C telegraphy and plate-modulated class-C telephony are not so critical as regards the actual value of the grid voltage as long as it is at least twice the cut-off value. For highest efficiency, the grid voltage in those services is often adjusted to values equal to several times cut-off.

POOR REGULATION

For plate-modulated class-C telephony, the AC-operated bias supply must be deliberately designed to have poor regulation, since the requirement of linearity in plate modulation necessitates that the class-C voltage level change with the modulation.

When modulation is transferred from the plate to the grid, however, the bias supply must be well regulated.

RF amplifier grid current flows through the bleeder resistor of the bias supply and the voltage drop developed across this resistor will alter the value of negative voltage applied to the amplifier grid. It is important, therefore, where regulation is at stake, to keep the bleeder resistance low in order to reduce the effect of its "grid-leak" action.

A typical AC-operated bias supply circuit is essentially identical with any conventional power supply unit, except that its positive output terminal and positive filter capacitor terminals are grounded.

Electrolytic capacitors having negatively-polarised cans cannot be fastened directly to the chassis of a bias supply for that reason. The filter chokes will also be found in the negative line.

A simple unit of this type would be entirely satisfactory for class-C telegraphy, plate-modulated class-C telephony, and class-A AF modulator service, but is not suitable for biasing class-B audio or grid-modulated class-C radiotelephone amplifiers because its voltage regulation is not apt to be good enough.

The supply is by-passed for RF by a small capacitor, the capacitance of which is chosen to offer low impedance at the transmitter frequency. This capacitor should be a good-grade mica component.

RECTIFIER TUBE

For low- and medium-voltage bias supplies, the rectifier tube may be either a high-vacuum or mercury-vapor type, although some designers advise against the use of mercury-vapor tubes because their discharge has been observed occasionally to modulate the biased-amplifier grid.

For class-C telegraphy, the resistance of the bleeder must be kept low in order to minimise grid-voltage variations due to presence of amplifier grid current in this resistor. The entire maximum transformer secondary current should be taken up by the bleeder, whose re-

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sistance should be small with respect to the recommended grid leak resistance.

The transformer must likewise be chosen that its secondary voltage and current will be adequate to develop the required grid voltage across the low value bleeder resistor.

The bleeder itself must be rated to withstand (with a good safety factor) the power developed by the rectifier output current and the amplifier grid current.

The matter of filtering depends upon which transmitter stage the bias supply is intended to operate into. In general, RF output amplifiers do not require as much bias-supply filtration as do low-level RF and AF stages and modulators.

For a modulator supply, for example, two filter chokes and capacitors would be recommended, while one choke and perhaps one capacitor might be eliminated if the bias supply were designed for the RF output amplifier.

FILTER RATING

The filter capacitors must be rated to withstand the peak secondary voltage delivered by the transformer (RMS voltage of one-half secondary winding x 1.41).

Very often, it is desired to obtain only safety bias from an AC-operated supply (as in plate-modulated class-C telephony) and to secure the remainder of the required grid voltage from a grid leak. The total voltage supplied by the two sources can then be made equal to the value recommended for the biased stage.

In such an arrangement, the grid leak is connected in series with the output of the bias unit. The bias supply is adjusted to deliver cut-off voltage at the grid terminal of the amplifier—in the absence of excitation.

The value of the grid leak is chosen such that the total resistance of grid leak and bias-supply bleeder will give a voltage drop with the normal amplifier grid-current flow sufficient to furnish the remainder of the desired grid voltage.

Good voltage regulation must be one of the outstanding characteristics of bias supplies employed with class B modulators, and grid-modulated RF amplifiers.

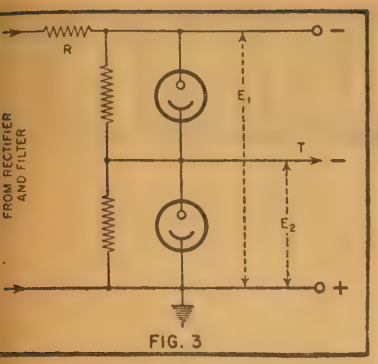
REGULATED SUPPLY

Equally important with regulation in the bias supply for a class-B modulator is the requirement that the actual value of voltage be within 5 pc of the required value.

The simple bias supply circuit previously described, may be converted into a regulated unit by the addition of small VR-type gaseous voltage-regulator tubes when the desired bias voltage corresponds to the normal drop across one or more of these simple tubes, or by the addition of more complex tube-type voltage regular sub-circuits.

When the desired bias voltage corresponds to the drop normally appearing across a single VR tube the familiar single VR tube circuit is applicable; when it is higher than the drop across one tube, several tubes may be connected in series provided the total drop across the series combination corresponds to the desired bias voltage.

The manner of connection is i



ıstrated by Figure 3. The value f the limiting resistor, R, would ormally be such that 25 milliam- eres will flow through the tube or ıbe combination. The power rat- ıg of this resistor must be suffi- ent to dissipate safely the power eveloped by the total current of ıbe and load.

When two or more VR tubes are ınnected in series as in Figure 3 ips, such as T, taken from the ınction points, will supply inter- ediate bias voltages equal to the tal drop across all tubes between ıe tap and ground.

It is clear that a number of series ombinations may be worked out ith VR75, VR90, VR105, and R150 type tubes to give various egulated voltages from a single bias ıpply.

The above remarks assume that ıe current which the regulator ıbes can pass is adequate for regu- tion at the anticipated peak load. not, some higher current form of egulation must be provided.

The connection of light duty regu- tor tubes in parallel is likely to e unsatisfactory unless the circuit an be arranged to ensure that both ıbes strike and therefore share the ad.

Other types of voltage-regulated ower supply circuits are likewise seful as bias units, provided the tal resistance of the bleeder in ch a circuit is not an appreciable ercentage of the normal grid leak ecommended for the biased stage.

An example of such a circuit is ıe familiar triode-pentode-neon ıbe unit, such as the 6SJ7-6A3 and 7-2A3 arrangements. When power ıpplies of this type are employed r class-B audio bias, the bleeder esistor must be especially low in alue.

As mentioned in connection with ıe simple AC circuit safety bias ay also be obtained from a volt- ge-regulated supply unit, the re- ainder of the grid voltage being eveloped by a series grid leak. his scheme cannot be used, how- ver, with class-B audio and grid- odulated class-C telephony.

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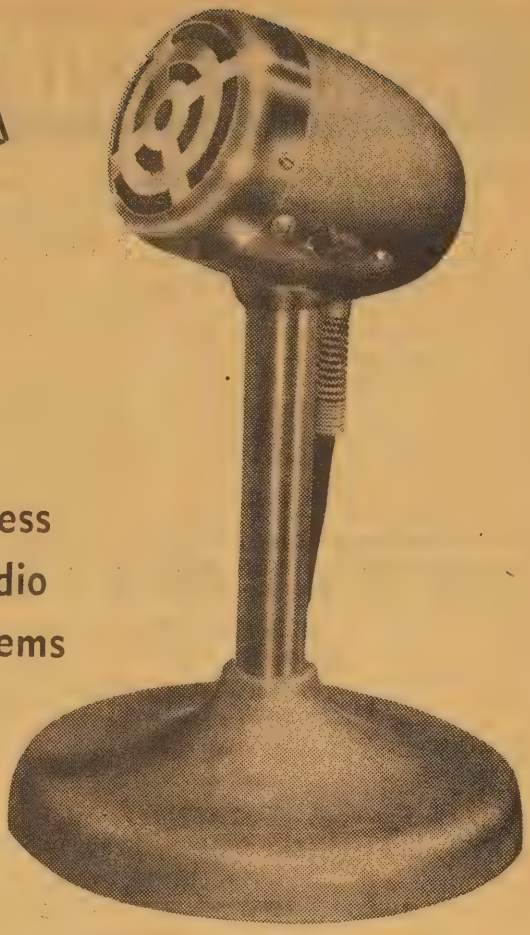

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ALTHOUGH we have known of the loopstick for quite a while — so also have many local manufacturers —it has not been possible to mass-produce them because of a lack of the necessary moulded rods.

Just recently, an initial shipment of suitable rods was brought into the country by the Philips organisation and we were able to make up and test a couple of samples. It would certainly appear that claims for the loop-stick are well founded.

The principle of operation is simple enough: —

What is virtually the first grid coil in the receiver is wound on an oversize iron slug. The samples we used measured no less than 8 1-8th in. long by 3-8th in. diameter. The unit is mounted within the cabinet and connected to the grid circuit by a pair of twisted leads, as with an ordinary loop aerial.

Like the loop aerial, the loop-stick must be kept as clear as possible from the receiver chassis and the batteries. A clearance of about an inch appears to be adequate.

It has the big advantage, however, that the requirement can be satisfied very much more easily, because of its shape, without prejudice to the design of the cabinet.

In operation, the large ferrous rod provides a low reluctance (or high permeability) path for radio signals in space. Lines of force adjacent to the assembly, therefore, tend to bend so as to pass through the rod. In so doing, they link with the flux lines of the resonant grid coil wound around it.

OPPOSITE FUNCTION

In other words, the loop-stick is just the opposite in function from the loop aerial.

The loop aerial takes the tuned circuit to the signal field by expanding the coil to the maximum possible dimensions. The loop-stick brings the signal field to the coil by leading it through an oversize ferrous slug.

The efficiency of the loop-stick depends largely on the size and permeability of the "stick", although the rods we used are probably the longest that will be needed in practice. Some rods are much shorter, others considerably thicker.

According to reports, attempts have been made to produce a loop-stick by loading a small diameter coil former with a large number of small powdered iron slugs. Results are said to be disappointing, however.

A great deal of stress is laid on the composition of the core but there has been no opportunity as yet to examine possible claims and counter-claims.

The two loop-sticks we have tested were wound on Ferroxcube rods as marketed in Australia by the Philips organisation.

Contrary to common practice, these rods are not made from finely divided powdered iron.

NON-METALLIC

Ferroxcube products are made instead from non-metallic compounds of iron-oxide, mixed with oxides of other metals, notably manganese, nickel and zinc. They are natural insulators and will serve as a winding former, if necessary without extra insulation.

The rod shown at the top is the manufacturer's prototype, which carries a litz-wound coil on a small length of former. The coil was sealed in a position which gave the correct inductance value to track with standard commercial coils.

When installed in a typical portable cabinet, however, there was some evidence that the loop-stick was not tracking at the low frequency end of the band and we took up with the manufacturers the question of inductance adjustment.

In practice, the oscillator and R.F. coils have to be adjusted to track with the dial and it is not always

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5-6 ANGEL PLACE, SYDNEY

onvenient to track them to the loop, rticularly as the job can only be ne accurately with set installed in e cabinet.

It appears that the inductance of e coil can be varied over an adeiate range by sliding the coil along e rod. The position for highest inictance and highest efficiency is at e centre but the coil can allegedly moved away from centre by a ort distance to achieve correct acking, without too noticeable a loss efficiency.

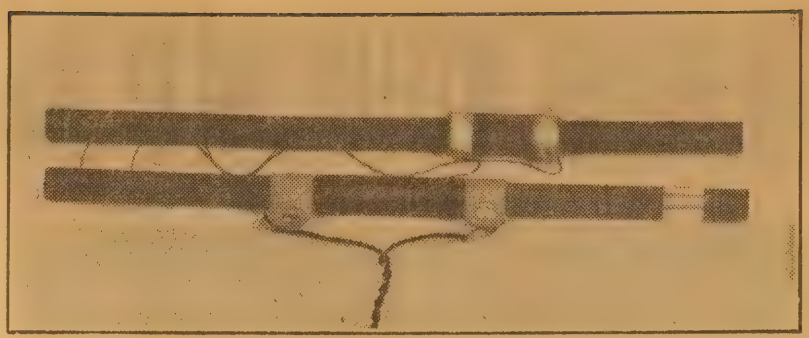
Some manufacturers may adopt is idea.

EW TURNS

By way of further investigation, owever, we set about to wind up a milar coil and were surprised to nd that fewer than 50 turns were quired to tune the broadcast band. We then produced a second loopick, this time with 45 turns of 19 & S enamelled wire, wound straight n the rod. A couple of riveted ore clips were provided, as shown the photograph, to anchor the ends. But how could we vary the inductnce for tracking purposes?

The solution, which is original as r as we know, proved to be exemely simple. We cut a small strip brass shim, about a half-inch wide, lled it once around the loop-stick nd soldered the ends. Acting as a gh-Q shorted turn, the little brass ide trims the inductance perfectly.

With our homemade loop-stick inalled in a five-valve portable, we eaked the inductance with the brass ide and also peaked the trimmer at e high frequency end of the band. e then repaired to the roof of our city office to observe its performance.



Two of the new "loop-stick" or "ferri-loop" aerials, which promise to replace conventional loops. The top one is a manufacturers' prototype, the bottom one is our own hand-wound version with a sliding shorted turn for inductance variation.

- It was streets ahead of what we had achieved with the original "Jubilee" portable and its necessarily small loop.
- It was a good deal better than the original "Rambler" with its loop of only moderate dimensions.
- It slightly bettered the big hand-wound loop we described last month.

In other words, a loop-stick of the dimensions specified looks like being equal to or better than the biggest loop you are likely to wind.

The loop-stick appears to operate best when placed horizontally and broadside on the station. It has a signal null when pointing approximately at the station.

Signals can be received with the loop-stick mounted vertically in the cabinet, but results from different stations vary and the average strength of signals is much less.

From the homebuilder's point of view, the loop-stick looks like being a most interesting development. It can be substituted easily for an ordinary loop and will provide much stronger signals in most cases.

Loop-sticks should become available commercially very shortly, but can be made up by hand very simply. The main problem will be the supply and distribution of suitable rods, which, incidentally, will cost several shillings apiece.

One small but important point, however. Don't try to mount your loop-stick with metal clips. They will act as a shorted turn and reduce the inductance.

We can see them becoming very popular, too, in mantel sets.

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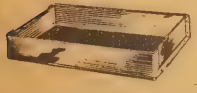

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We list the most popular sizes. All have welded ends. Specials made to order 50 pc extra charge.

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13 x 7 x 2½	12/6
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All steel 20G.
Black wrinkled finish, solidly constructed. Complete with panel. Three sizes:
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16 Gauge. .050in Thick.

6 x 5½,	3/-	14 x 8 ..	7/6
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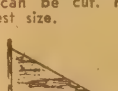
7 x 7	3/3	20 x 9 ..	12/3
9 x 8	4/10	24 x 12 ..	19/6
12 x 8	6/6		

Any size can be cut to order. For price take nearest size.

18 Gauge. .040in Thick.

7 x 7	2/6
9 x 8	3/8
12 x 8	4/9
14 x 8	5/9
18 x 9	8/6
16 x 12	9/9
20 x 9	9/3
24 x 12	14/6

Any size can be cut. For price take nearest size.



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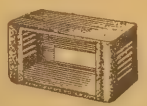

METAL CASES
Ventilated type. Black wrinkled finish, louvred sides, radius corners, loose front panel.
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ENAMEL WIRE
(B & S Gauge)

Size	100'	200'	300'
16	9/6	18/-	24/-
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Solder lugs	2/6 pkt.
Grid Clips	2/6 pkt.
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Self-Tapping Screws in packets, state the size	3/-
Coil Formers 6 pin 1¼in	3/9.

BAKELITE PANELS
We wil cut to any size required. A few sizes are listed.

7 x 7	6/-
9 x 8	8/-
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We take this opportunity of wishing our many clients the Compliments of the Season.

REMAKE YOUR OLD BATTERY AND

A complete power supply for personal portables described in October 1948. The extreme filtering in the filament supply would still be inadequate for sets with good bass response. A similar circuit for a 2.0 volt filament network would be just about a hopeless proposition.

amateur enthusiast, to whom time is not necessarily money.

Much the same could be said, of course, of any ageing receiver which needs a lot of attention—be it battery, vibrator, AC or anything else. A serviceman may be quite capable of dismantling and rebuilding a dial, installing a new wavechange switch, changing over valve sockets and so on but, because he has to live by selling time, his final charge for labor may dwarf the value of the set itself.

WOULD COST TOO MUCH

That is why one frequently sees a clearance of ageing but still-respectable sets offered to the public "with all faults" for a couple of pounds a piece. Accumulated as "trade-ins" they simply demand too much time and effort to warrant selling as second-hand sets, "reconditioned and fully guaranteed".

However, a resourceful enthusiast can often take such a set home, spend a few evenings cleaning up the controls and wiring, change an odd socket, recondition the cabinet and so on, and finish up with a very useful and a very cheap receiver.

Whether a set is worth such treatment depends naturally on its age and quality. The cabinet must be

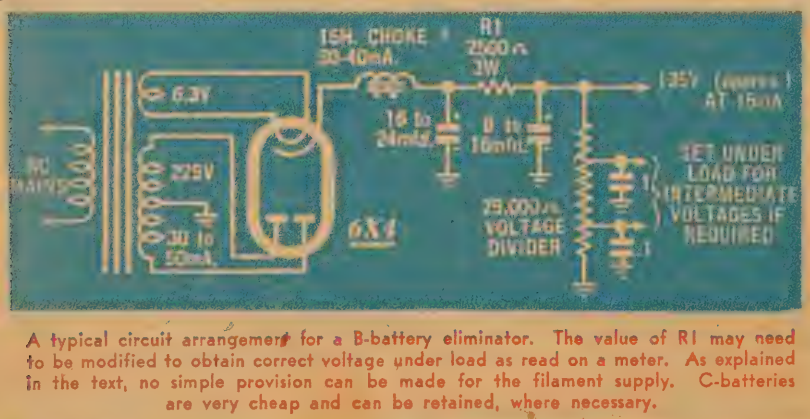
Converting battery or vibrator sets for AC operation is hardly the kind of activity a serviceman would choose to earn a living. Nor would he seek to make money by renovating old receivers. However, that kind of problem often presents itself to a non-professional radio enthusiast and the following remarks on the subject may prove helpful.

WHILE the article is couched in general terms, it started out as the story of a particular set, which the writer undertook to convert to mains operation as a purely personal favor. Only on that basis, could such a job really be justified.

The question of converting battery or vibrator sets to AC operation is one which is, in fact, raised quite frequently by Radio and Hobbies readers. It follows naturally as power mains are extended or as readers move into new districts where power is available.

Many, of course, have the idea that conversion to mains operation is a simple matter. They remember the popular "eliminators" of the early days.

In point of fact, it is not easy to convert a traditional battery set for mains operation and, on a purely service contract basis, it may never be worthwhile. The person most likely to "make a go of it" is the



A typical circuit arrangement for a B-battery eliminator. The value of R1 may need to be modified to obtain correct voltage under load as read on a meter. As explained in the text, no simple provision can be made for the filament supply. C-batteries are very cheap and can be retained, where necessary.

capable of reclamation and the chassis must carry a good set of coils and IF transformers, a good gang and a suitable dial. Nor should the power transformer be forgotten.

As a matter of course one must expect to purchase new electrolytics and a few odd wiring parts, even a valve or two, but there can be no "bargain" about a set which also needs a new coil kit, gang and dial.

BEWARE OF THESE

By and large, the sets which do not warrant renovation are the very old TRF's and superhets with "bath-tub" tuning gangs, rickety shield cans and valves of the "screen grid" era —24's, 27's, 35's, 47's and the like.

Some of these sets were good enough but, for the most part, they were built in the days when designers were only just learning how to mass-produce that type of receiver.

A little later, with the coming of valves like the 57, 58, 2A5, &c., and more particularly with their 6.3-volt counterparts, the associated coils, IF transformers and gangs achieved consistently better quality. And they've continued to improve gradually ever since.

No job of renovation is likely to be

VIBRATOR SETS FOR AC POWER

by Neville Williams

worthwhile unless there's a good basis to start from.

Getting back to battery sets, the same general remarks apply, but with even greater force when conversion to mains operation is contemplated. One must be very sure that the cabinet, chassis-work and tuning circuits are sound before the expense of new valves and power equipment can be justified.

This rules out forthwith all the old TRF's, neutrodynes and bakelite panel jobs, no matter how well they may have performed in bygone days. The vastly increased number of broadcast stations now in operation makes far too great a demand on their powers of selectivity and the problem is further aggravated if they are required to operate near one or more powerful locals.

BATTERY SETS

Even battery sets from the "screen-grid era", using valves like the 32 and 34, are likely to be of dubious quality because of primitive design in the coils and IF transformers.

Just as "modern" design emerged in AC sets with pentodes and pentagrid converters, so the equivalent stage in battery sets wes largely marked by the Australian 1C4, 1K4, 1D4 series. On the average, sets built around these valves or their later equivalents may be worth rebuilding with AC valves and components.

But why talk of new valves and power equipment? Why can't the existing valves be run from AC? These questions are frequently posed. To answer them calls for an examination of battery set requirements.

The average battery set needs a high tension supply between 90 and 135 volts at a current drain of between 10 and 15 milliamps. This can very easily be provided and fully filtered using a conventional rectifier valve, a small power transformer, a small filter choke, and so on.

HIGH TENSION

The high tension supply involves no more difficulty now than it did in the days when B-battery eliminators were so popular.

The filament supply is a very different proposition because it involves a low voltage—six volts or less——at a relatively high current —up to 0.75 amp.

It cannot be AC, straight from a transformer, because the varying potential across the filaments and the consequent rapid variation in temperature produces an intolerable amount of hum in the output.

Nor is it sufficient merely to rectify the AC before application to the filaments. Without filtering, the potential still varies between wide limits and the hum trouble remains.

Unfortunately it is difficult to filter adequately a low-voltage high-current supply. In practice, using the largest available condensers and chokes of reasonable dimensions, the hum is still likely to be of a prohibitive order.

Another problem is that of voltage regulation, which is generally poor in a supply of this nature. Even though the potential may be adjusted accurately with all valves drawing current, it will rise considerably should one valve fail. The failure of a second valve, as a result of this rise, will impose more hardship on the remaining valves, and so on "ad destructum".

Our only successful approach to date to this type of filament supply was one for personal portables, where we used a 1.5 volt cell in the combined role of filter and voltage regulator. Even then the hum level could be ignored only because of the poor bass response in a baby set.

Modern portable battery sets, like our recent Jubilee and Rambler, can operate from AC mains only because they use low current filaments connected in series rather than parallel.

Since the drain of the whole set is only 65 milliamps, it can be filtered by conventional means. An examination of the abovementioned circuits will illustrate the point.

It may therefore be stated that although the high tension requirements of a battery set can be met easily with an eliminator, the low tension (or filament) circuit cannot be supplied in equivalent fashion.

The best that can be suggested as a short-term measure is to build a small high tension supply to replace the B batteries, retaining the A battery to operate the filaments. If need be, this can be kept in condition with a permanent trickle charge.

Typical eliminator and trickle charger circuits are suggested as a basis of experiment.

SERIES WIRING

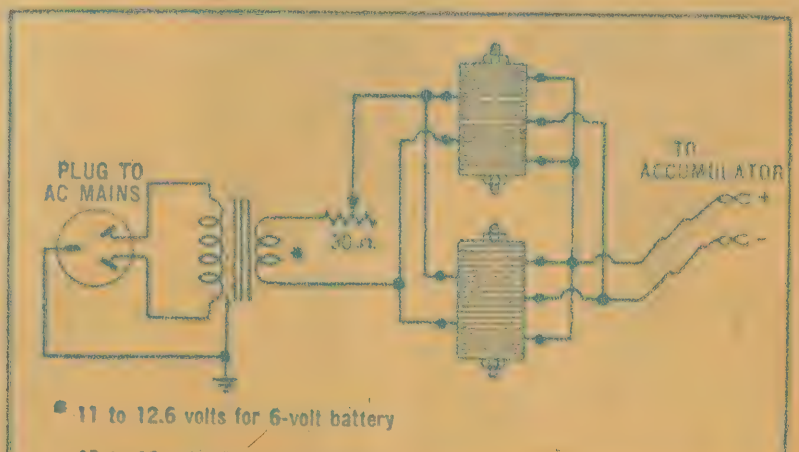
There remains, of course, the possibility of wiring the filaments in series rather than in parallel, thereby simplifying the filtering problem. Unfortunately, most of the older sets would require a minimum series current of 120 milliamps, even assuming that a 1F4 or 1F5-G were substituted for the more usual 1D4 or 1L5-G.

This, added to the high tension drain, puts the figure beyond the rating of the popular 5Y3-G rectifier and, in general, calls for rather massive components.

There is the added complication that a series filament connection calls for a complete rearrangement of the biasing and AVC circuits to preserve normal operation of the valves. Not many enthusiasts are able to tackle this amount of new design and, taken together with the cost of the job anyway, the idea loses much of its attraction.

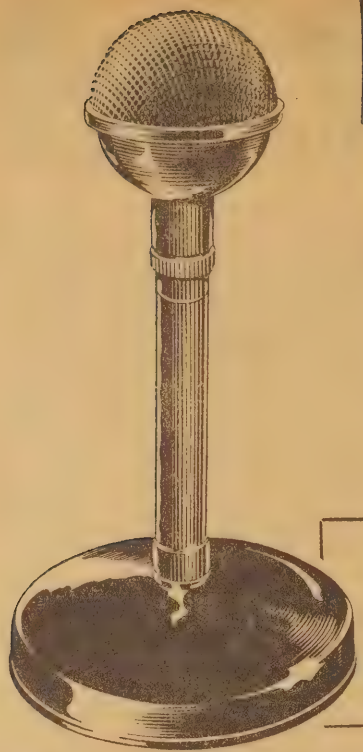
Even vibrator sets are not free from this complication because their filaments are in series—parallel and the conversion to a purely series network would involve new design problems.

As in the case of ordinary filament circuits, it is extremely doubtful whether one could arrange a 6-volt



A-battery eliminators are impractical for most battery sets, and the accumulator must be retained. It can be kept in condition by a permanent trickle charge using a small transformer and a couple of telephone type rectifiers. About 8.5 volts, as from a bell transformer, would be required for a 2-volt accumulator.

"ACOS" CRYSTAL MICROPHONES



MICROPHONE TYPE MIC 22

Mic 22 is available in 2 types.
Mic 22/2 being complete with desk stand as illustrated.
Mic 22/1 consists of the microphone with nickel plated stem at the end of which is fitted a screwed adaptor which will fit British or American type standard floor stands.
Mic 22/1 can also be used as an effective hand microphone.

MIC 22
PRICE
£9/18/6

SPECIFICATION

Output impedance . . . Equivalent to approximately .002 MFD. (.8 megohm at 100 cycles)
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Frequency response . . . Substantially flat from 40 to 6,000 cps.
Recommended load resistance . Not less than 5 megohms
Output level . . Minus 50 db below 1 bolt/bar.

MIC 28 LAPEL MICROPHONE

Impedance 100,000 ohms at 1,000 cps.
Capacity .0015 mfd at 24 deg. C.
Output level approximately .55db. Ref. 1 volt/dyne/cm2.
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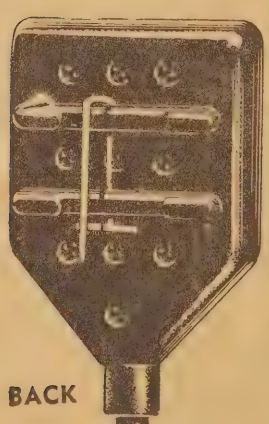
This small non-directional microphone has been designed to allow freedom of movement for public speakers or broadcasters. The dimensions of the MIC 28 are 1 9-16in. wide by 2½in long by 5-8in thick. It is housed in a soft moulded rubber case which gives added protection against shock. The microphone hooks on to the lapel of a suit or coat. A 6' cable is supplied The MIC 28 has a level frequency response throughout the whole of the audible frequency spectrum, and consequently gives excellent fidelity of reproduction.



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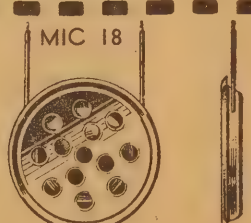
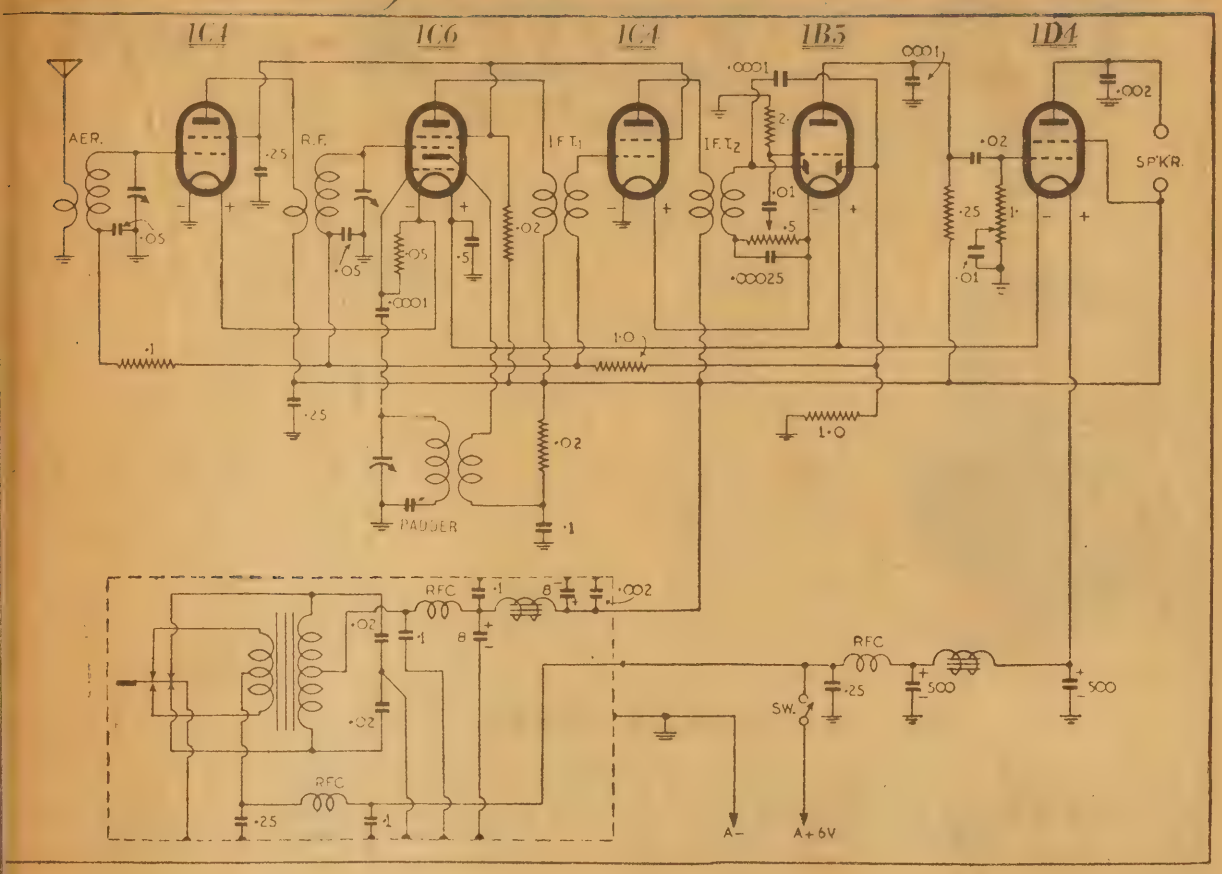


MIC 18. Microphone Speech insert provides high acoustic qualities with minimum bulk. Where exceptional slimness is required, this insert is recommended. Overall dimensions 1-7/16in. Price 39/6.

MIC 32. Sintercel fulfils the r quirements for a flat insert wi good sensitivity and a fr quency response 30-7000 c/s. U affected by vibration, excep tionally robust constructio Overall dimensions 1-7/10in. Pric £2/15/6.

TYPICAL VIBRATOR SET USED FOR A REBUILD



This circuit is fairly typical of vibrator sets using the Australian series of valves. This was the type of set which the writer undertook to renovate and convert to AC operation. The AC version appears on the next page.

pply for a vibrator set, even ough it will already have some in- uilt filtering.

At the very least, it would call r a special transformer and a metal ctifier of the type used in the Radio nd Hobbies battery charger. After rchasing these and an array of LT lter chokes and condensers, the cost ould be considerable, anyway.

VIBRATOR SET

The receiver which we started off tell you about actually was a brator set, running from the usual volt accumulator. When moving to e city some years ago the prob- ms of conversion influenced the wner merely to purchase a second- and low-current charger, which has en used ever since to keep the bat- ry topped up.

The battery has naturally deterior- ed till, recently, it has done little ore than act as a filter device, most the power to operate the set flow- g straight out of the charger.

The practical objection to the heme is that one can't carry a bat- ry and charger around from room room, along with a mantel type ceiver. Nor can one completely for- t the obligation to charge the bat- ry at intervals between use.

These considerations finally forced e owner to seek a decision as to hether the set should be scrapped or modified for AC operation—on the aforesaid "personal favor" basis. That was where the writer came into the picture.

Examination of the receiver showed it to have mainly Australian-designed valves—1C4 RF, 1C6 converter, 1C4 IF, 1B5 diode/amplifier and 1L5 output. The station-to-station performance was excellent, which spoke well for the tuning circuits. It transpired that the IF channel was on 175 Kc, which partly accounted for the high gain and selectivity.

To buy a complete new set of valves would obviously have involved an immediate and substantial outlay and first efforts were directed toward locating serviceable valves from a cheaper source.

VALVE REPLACEMENT

The spare parts box yielded some; others were types purchased cheaply from disposals sources. A virtually new VR55, for example, cost 2/- — a lot cheaper than a new 6B6-G, for which it is the exact equivalent!

There is every point, when renovating a set, in using valves of the same general class as the ones they replace. To substitute modern, high-performance miniatures for valves of mediocre Gm is just asking for trouble with instability.

Having located sufficient cheap, yet serviceable valves, the rest of the job became routine.

First job was to remove the box containing the vibrator supply, together with the accumulator wiring, low tension filter components, and so on.

This, together with removal of all valves, revealed a good deal of dirt and mess, which was cleaned up with a petrol-soaked rag and brush. Unfortunately, the surface of the chassis was corroded in quite a few spots under the bronze lacquer spray. What could be done to prevent further corrosion?

CHASSIS FINISH

A silver-sprayed chassis can be treated with aluminium paint, either brushed on or rubbed on with a piece of rag, but fancy colors are a different story. We tried some so-called "gold paint," but with every indication that the end result would be worse than the beginning.

The course finally adopted, after cleaning, was to paint over the entire upper surface of the chassis with clear lacquer, using a small brush to get into the inaccessible places. We treated the rather dull plating of the gang frame in similar fashion, likewise the frame of the speaker.

A few minutes' work transformed a dull-looking set into one that shone with an unaccustomed lustre—

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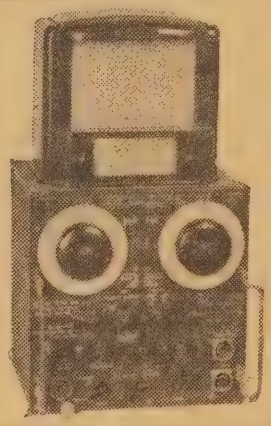

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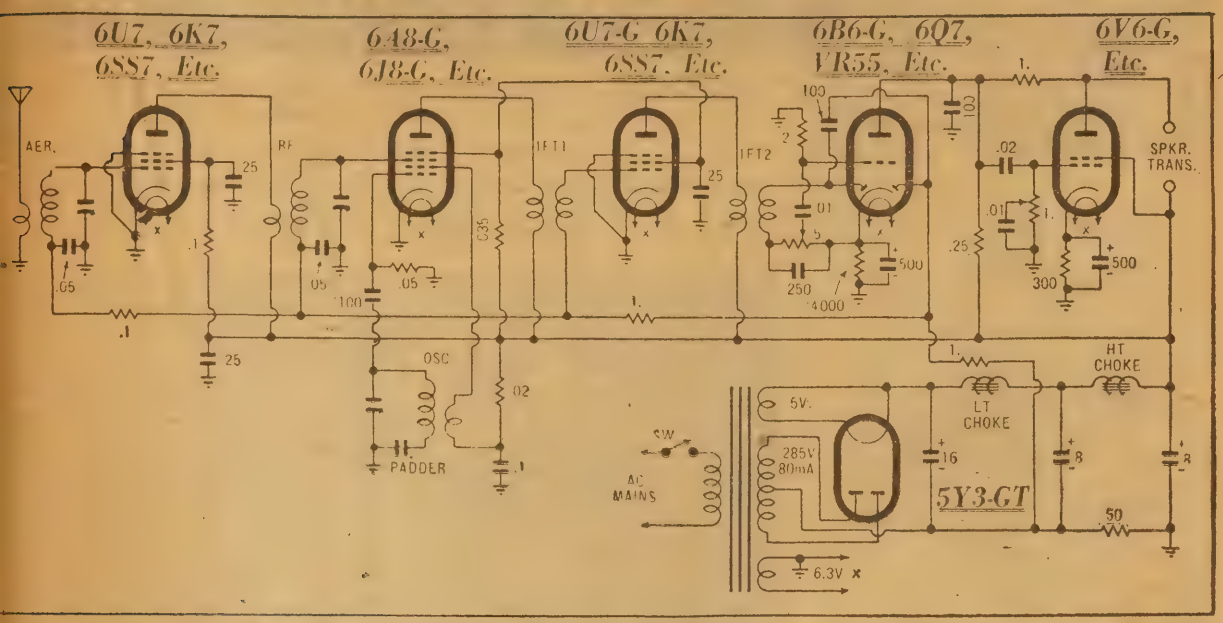
HOW VIBRATOR SET WORKED OUT WHEN REBUILT



How the finished set worked out with AC valves and power supply. The conversion was effected stage by stage, working back from the power supply and output, to simplify indentification of leads and components.

ot to mention the value of such a reatment against further deteriora-on.

Without disturbing any of the her wiring, we proceeded next vening to instal, in place of the brator supply, an upright type ower transformer, a rectifier socket d a couple of new filter condensers.

The original vibrator supply had ntained two filter chokes, LT and T, both about the size of an ordin-y speaker transformer.

Rather than waste the LT choke, e decided to wire it back into the T filter, for what little contribu-on it might make to the smoothing. he regular HT choke showed a re-stance of 300 ohms and this, taken gether with its size, indicated that e wire would be heavy enough to rry 60 or 70 milliamps. At least was worth a trial.

In point of fact, the two chokes ve ample filtering and saved the st of a new component.

VC BIAS

Provision was made, in wiring the ower supply, to provide a small gative bias for the AVC line. This ould save having to worry about thode resistors and condensers in e preliminary stages.

Having wired in the power supply, tention was next turned to the out-it stage where a 5-pin socket had commodated a 1D4 battery pen-de. Most of the wires from this cket led away to a complicated oking resistor panel along the rear ge of the chassis.

We lifted away the filament wir-g, as being of no value, but traced it the grid wire which led to a 5 meg. resistor—obviously the iginal grid leak. There was an ually obvious coupling condenser the preceding plate, a potenti-neter that could have been only a ne control, plus wiring to the screen n that would be the high tension circuit for the remainder of the set.

Having made a note of these leads, the 5-pin socket was disconnected and replaced with an octal socket having the same mounting centres—thereby saving on extra holes. Wires were run to the heater pins, B-plus was led from the power supply to the screen pin and connections were made to the plate and grid.

Finally the cathode resistor was installed and bypassed by one of the low voltage electrolytics taken from the vibrator supply. (They don't seem to mind a few volts overload.)

TONE CONTROL

The tone control potentiometer was dismantled and cleaned and a smear of lead from a 6B pencil rubbed over the element. Reassembled with a spot of oil on the shaft bearing, it operated smoothly and read close enough to the marked value.

A wafer switch, used originally as a battery off-on, was cleaned with petrol and a toothbrush, then reassembled with a spot of oil on the shaft and the locating ball. This was then wired as a mains switch, using the contacts least accessible to probing fingers.

At this stage we switched the set on for a few moments, getting a faint buzz when the 6V6 grid was touched with a screwdriver. The switch, power supply, output stage and tone control were now okay. So far, so good!

In similar fashion, we examined the diode-triode socket, located the plate supply circuit, the volume control wiring, the diode and AVC leads leads and so on. This socket was then lifted out and replaced by an octal to take the equivalent AC type.

Two new leads were necessary to the heater circuit, plus a cathode bias resistor and yet another low voltage electrolytic from the original vibrator supply.

After repairs to the volume control, the entire audio system was checked and passed as "operational".

So the same process was followed, through the IF amplifier and the converter, the idea of working stage by stage proving valuable because none of the leads was coded in any way.

The AVC return was identified and returned to back-bias, allowing the cathodes of the first three valves to be earthed. Modifications had to be made also to the value of screen feed resistors and the oscillator anode supply to suit the new valves.

In addition, the RF amplifier was given a separate screen feed, in the interests of stability, this calling for an extra resistor and by-pass. Actually the latter was a 0.5 tubular which had become surplus from the filament network.

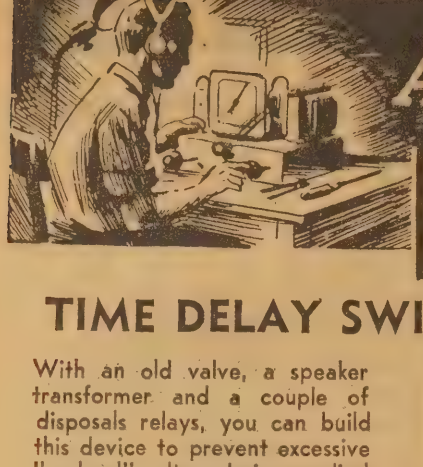
THE CABINET

Had the set been equipped originally with octal-based valves, the problem would have been that much simpler, because the sockets would not have needed changing and many of the leads would have been correctly positioned for the AC types. However, a little forethought in getting the right kind of sockets had saved most of the worry of changing them over.

Having checked the voltages and aligned the set, it performed in excellent fashion and was put aside for a trial run on the bench. If any condensers were going to break down under the higher operating voltages, now was the time for them to do it!

That left only the cabinet to worry about—a routine veneered table model, sprayed finish and edges

(Continued on Page 112)

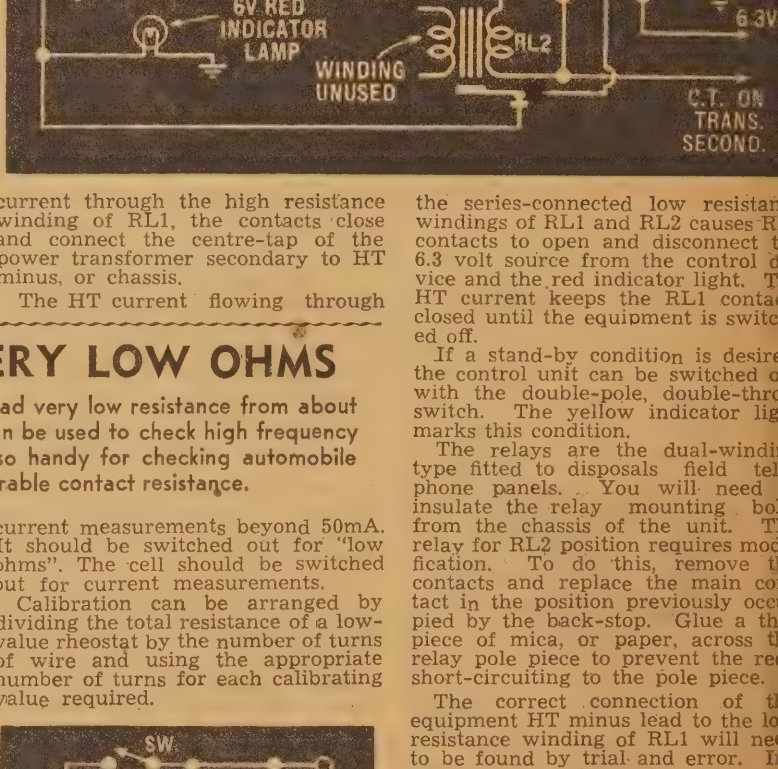


A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

TIME DELAY SWITCH SAFEGUARDS POWER SUPPLY

With an old valve, a speaker transformer and a couple of disposals relays, you can build this device to prevent excessive "no load" voltage being applied to the filter capacitors in an amplifier or similar equipment. It delays the application of HT until the valve heaters have reached operating temperature.



OUR contributor is Mr. G. B. Wolfe, Box 56, Bombala, NSW.

The device functions in the following manner.—At rest, the contacts of relay RL1 are open and those of RL2 are closed. When the equipment being safeguarded is switched on, the closed contacts of RL2 pass current from a 6.3 volt winding (which has one side earthed) to the heater of the control valve and to the voice coil winding of a speaker transformer.

The rheostat in series with the control valve heater allows this valve to heat up more slowly than those in the equipment. When it passes sufficient current through the high resistance winding of RL1, the contacts close and connect the centre-tap of the power transformer secondary to HT minus, or chassis.

The HT current flowing through the series-connected low resistar windings of RL1 and RL2 causes R contacts to open and disconnect t 6.3 volt source from the control d vice and the red indicator light. T HT current keeps the RL1 conta closed until the equipment is switc ed off.

If a stand-by condition is desire the control unit can be switched o with the double-pole, double-thro switch. The yellow indicator lig marks this condition.

The relays are the dual-windi type fitted to disposals field tel phone panels. You will need insulate the relay mounting bo from the chassis of the unit. T relay for RL2 position requires mod fication. To do this, remove t contacts and replace the main co tact in the position previously occ pied by the back-stop. Glue a th piece of mica, or paper, across t relay pole piece to prevent the re short-circuiting to the pole piece.

The correct connection of t equipment HT minus lead to the lo resistance winding of RL1 will ne to be found by trial and error. I correct connection will cause t relay contacts to chatter, due to inte ference with the magnetising fie already set up by the current throug the high resistance winding.

The control valve may be a power pentode, aged or otherwis The screen is tied to the anode a the control grid tied to the cathod Our contributor used a discarded 4

The rheostat will need to be of t very low resistance type, around ohms, usually found in the very o style battery sets. It will give som control over the delay time intro duced by the unit.

The control need not pass any mo current than required to close RL positively.

METER READS VERY LOW OHMS

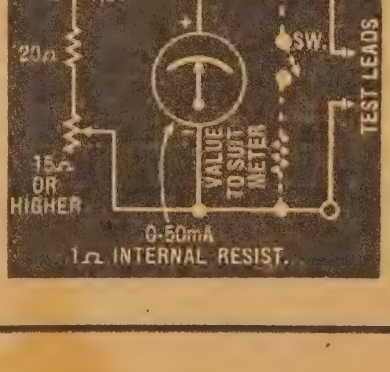
This simple device will allow you to read very low resistance from about 8 ohms down to around .05 ohms. It can be used to check high frequency coils, dry soldered joints, &c. It is also handy for checking automobile electrical systems for undesirable contact resistance.

THE idea is submitted by Mr. C. Gates, of Ubinia, Balladoran, 4W, NSW. The meter used is a 50 mA movement having an internal resistance of 1 ohm. In operation, a 1.5 volt torch cell passes current through the meter, the total series resistance being adjusted so that the meter registers full-scale deflection. When the resistance to be measured is placed across the meter, it effectively shunts the movement and the meter will register a lower value, depending upon the magnitude of the shunting resistance.

Theoretically, a shunting resistance of about .02 ohm should cause the meter to read 1-50th full-scale, or 1 mA, but due to the inevitable resistance of the test leads, actual calibration of the scale is necessary. Of course, the scale markings could be used if the resistance of the test leads is subtracted from each reading. The same set of test leads should be used with the meter at all times.

If a 50 mA 1 ohm meter is not available, a 5 mA 10 ohm movement with a 1.1 ohm permanent shunt across it can be regarded as a 50 mA meter. The dotted portion of the circuit allows the meter to be used for current measurements beyond 50mA. It should be switched out for "low ohms". The cell should be switched out for current measurements.

Calibration can be arranged by dividing the total resistance of a low-value rheostat by the number of turns of wire and using the appropriate number of turns for each calibrating value required.



TRADE REVIEWS AND RELEASES

"IRONCORE" PRODUCING WIDE RANGE OF TRANSFORMERS

Ironcore Transformers Pty. Ltd. are now producing a wide range of electrical and radio transformers —the latter eminently suitable for home-built radio equipment. Ironcore advertises their products as "unconditionally guaranteed for five years."

PERUSAL of the "Ironcore" catalogue reveals a range of all electrical transformers suitle for bell ringing, model trains, ad lights, soldering irons and elec- c fences.

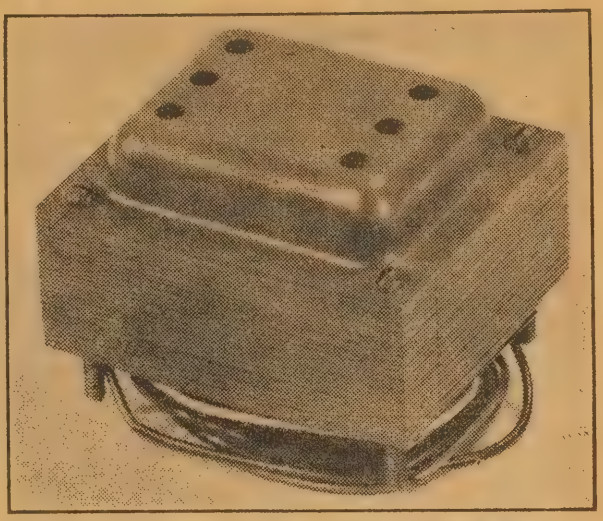
Amongst the larger electrical transrmers is a complete range of step-wn transformers, 240-volt to 32-lt or 110-volt. These range in ze from a 20-watt unit retailing at /14/4 to a 2.5 KW unit retailing r £75/16/6.

The "radio" type of transformers ry in size from a small 40-milli-np type with 225-volt and 6.3-volt condaries to a 385-volt, 200-milli-np type, with three separate heat-windings.

The above transformers can be pplied as required with horizontal vertical mounting and filter chokes e available in matching finish.

"Ironcore" lay claim to a specially gh standard of finish and inspec-on, the transformer windings being sealed after manufacture with a high melting point wax.

Supplies are available through trade houses. The manufacturer's Sydney address is given as 83 Great Buckingham St., Redfern, NSW.



A flat mounting "Ironcore" transformer, finished in grey lacquer. This is type T5/12, a 40-Milliamp 225 volt unit. The lead wires connect to copper strips protruding from the windings.

A NEW RANGE OF MICROPHONES

Hodges Sound Systems, of Lewis St., Balgowlah, NSW, have recently released the first items in a new range of microphones and sound equipment accessories. They plan to extend their range gradually to cover all normal requirements in this field

The H.S.S. model 4CS crystal microphone, with desk stand. The case is diecast aluminium, the grille chromium plate.

PICTURED at the left is the H.S.S. model 4CS crystal mircophone on its "take-apart" desk stand.

The microphone housing is made from diecast aluminium alloy and finished in a silver-grey Hammertone enamel. It comes complete with 12ft of rubber covered microphone cable.

The slide type off-on switch is an optional feature and denoted in the type number by the suffix "S".

Models 4C and 4CS (with switch) are general purpose types, for either music or speech reproduction. Models 4CV and 4CVS are lower priced and contain an insert which is intended primarily for speech work, such as for amateur radio, paging systems, &c.

The desk stand illustrated is finished to match the microphone and has the unusual feature that the centre tube screws out of the base as well as detaching from the microphone. This simplifies stowage and also allows the plated column to be used, if required, as a grip when the microphone is to be held in the hand. The full circle rubber ring is set into the underside of the base.

H.S.S. are also marketing a line of all-purpose single-contact connectors, plus other accessories.

TAPE HEADS FROM NOVA

PICTURED below are a typical pair of tape heads currently being offered by the Nova Electric and Engineering Co., of 311 Sussex St., Sydney.

Externally, the heads are well finished in heavy chrome plate and are arranged for single hole mounting in the deck. A novel feature is that the cover is not fixed but is held in place with an internal spring clip. It can be slid up or down by finger pressure, allowing the guide track position to be varied in respect to the gap.

Thus, in the case of half-track heads, it is possible to use the heads for either upper or lower track recording. Azimuth adjustment is also provided.

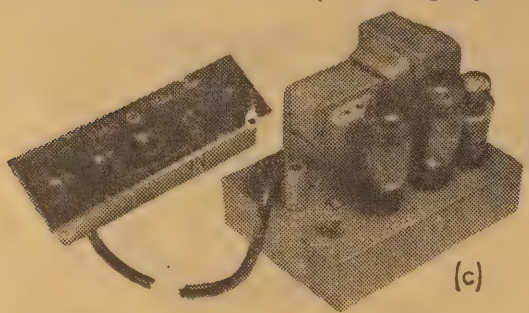
By way of a test, a pair of the heads was coupled to an R & H tape amplifier and observations made on frequency response and general performance. The heads performed in quite satisfactory fashion with a level response to better than 6KC. The response would normally extend beyond this with the use of an amplifier peaked at around the 8Kc. region.

Retail price for the heads is quoted as £4/19/6.

The Low Down o

SPECIALLY DESIGNED COMPONEN

Hi-fi, or high fidelity, marks a revolution in music recording and reproduction. It is the most realistic reproduction of sound that you can buy—so realistic, so superior to the ordinary radio—phonograph reproduction that music lovers, long and sh haired alike, are discarding their old and installing hi-fi systems. Let hi-fi its way into your home.



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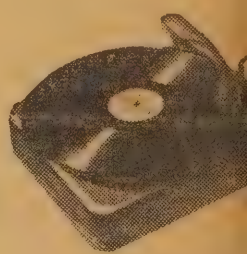

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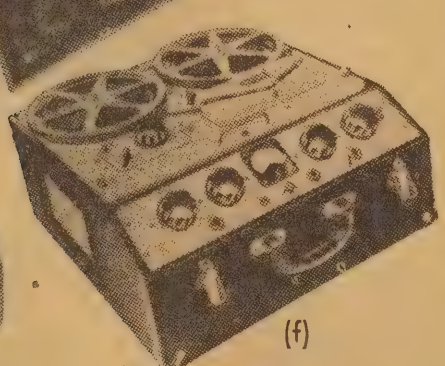

(f)

(g)

(a) The Decca 33AG Playing desk — the first step to fidelity. Plugs into standard radiogram to play microg recordings. With an additional head gives new repro tion from existing libraries of standard recordings. £14

(b) The new Plessey multispeed intermix record cha Fully automatic, 3 speeds. Latest wide response micr crystal pickup. An ideal unit to incorporate in pr radiograms to convert to long playing and give impr sound from old favourites. £22/1/-.

(c) The new M120 — 5A HIGH FIDELITY AMPLI incorporating the improved Fidelity Control unit. Inde dent control of bass or treble. Sharp cut-off filter minimising scratch on old records. £68/2/8.

(d) Goodmans Audiom 50. All modern receivers are but reproduction is "strained" through a cheap spe This Junior Goodmans will improve your radiogra table model. £11/19/9.

(e) R21A Miniature Tuner. Companion unit to the amplifier. Panel matches tone control unit. Size 11 4in x 4½in. £16/10/-.

(f) The Ferrograph 2A Magnetic Recorder. Tape rec ings at its best. Two tracks. Two speeds. Response 10,000 cps. Plus-minus 3DB. £185/12/6. (Delivery—m mum 3 months.)

(g) Decca — Britain's finest pickup. Moving iron revolutionary semi-permanent stylus. Flat response 30 to 15,000 cps. Robust and non-critical to lower p motors. Stocks to arrive soon. £15/15/-.

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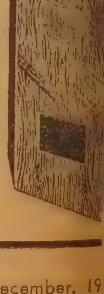

An artist's impression of the completed Corner Reflex Cabinet for the Axiom 150 Mk.11.

HIGH FIDELITY

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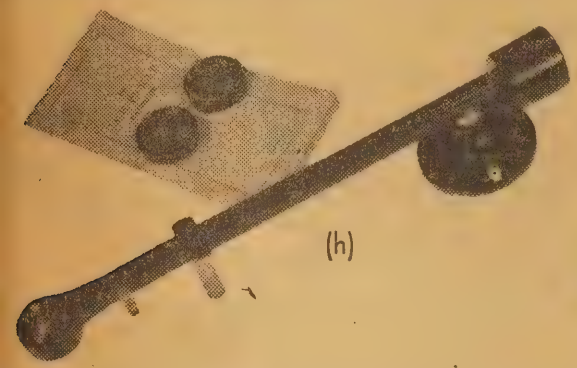
sic can be only as good as the "ears" the set that captures and reproduces it. ere, to your hand, is all the equipment reproducing music, whether it be trumental, massed or vocal, to give you reproduction as perfect as though you are present at the actual performance. Be the cost high or low, the product is PERFECT of its kind.



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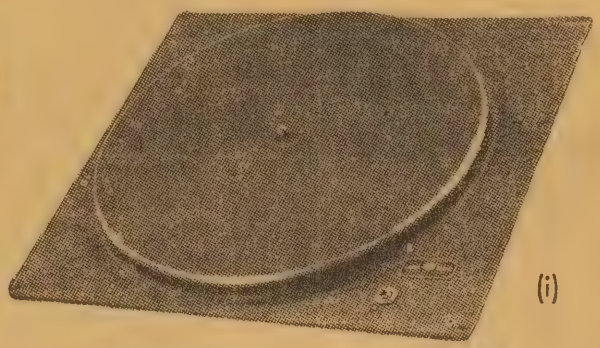

(i)

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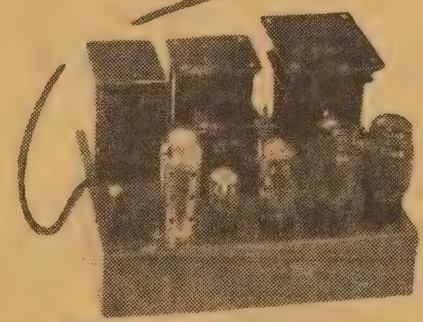
GOODMANS AXIOM 150 MARK 11. This 12in high ty loudspeaker has a twin curvilinear diaphragm. flux of 158,000 maxwells on a 1¾in pole. Dustproof. resonance 35cps. Frequency response 30 to 15,000 **£21/16/8.**

An artist's impression of the completed Bass Reflex Cabinet for the Axiom 150 Mk.11.

(j)



(k)

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(m)

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OFF THE RECORD — NEWS & REVIEWS

There have always been bitter differences of opinion about the musical stature of Richard Wagner. It is probable that there always will be. But on one point there is rarely any serious disagreement. Anyone who has any familiarity at all with the "Mastersingers of Nurnburg" is prepared to give it the highest praise as being unique among Wagner's mighty works, the most human and appealing of them all.

By JOHN MOYLE

IT is true that in order to see furthest into the great music dramas of Wagner, one must be prepared to go unreservedly—I was almost going to say quietly. It is hard these days to be reconciled to stories of impossible gods and heroes whose behavior has no relation to reason or logic, who can perform the most unrelated, amazing and convenient feats to further the plot, or to listen sympathetically to the passionate agitations following the consumption of a love potion.

It's not unreasonable, I think, to register such reactions these days, for we do not generally allow legend and superstition into our thinking as was common a hundred years ago. We are conditioned to new proportions, and used to much more action in a short while. Unless we can become mentally reconciled to such backgrounds, we are going to find hours of Wagner very tedious.

FACT AND FANTASY

But because of the close weave between music and action which Wagner has created, we will lose considerable impact if we decide to ignore absurdities and inconsistencies in action and listen to the music alone. If art is an interpretation of life we are justified in sorting out fact and fantasy in our judgment of it.

There is little need for any awkward or intruding mental adjustments with the Mastersingers. It is a simple story of a singing competition for the hand of the fair Elsa, judged by the musical leaders of a village where such things as the art of singing are highly valued. The story can be found with variations in hundreds of folk tales. The characterisation is consistent with real people. The humor is simple and easily recognised. The music is sincere, colorful and magnificent.

The action, too, proceeds more quickly from situation to situation than in the other music dramas. There are a few longish monologues, it is true, but these are not complicated and even worth following. There is a regular procession of every vocal-orchestral combination, from simple, pastoral singing to great choral climaxes.

Columbia's records of Die Meistersingers von Nurnburg, which prompt these remarks, was made at the Bayreuth Festival, and were heard on the air long before their public release. Being made during an actual performance, there are an occasional "noises off" and some lack of balance which would not occur in a studio performance. But I doubt whether any studio version could convey that sense of real life which these records undoubtedly possess.

The list of performers is impressive, and too long to give here. Among them are Elisabeth Schwartzkopf as Eva, Hans Hopf as Walther, and Otto Edelmann as Hans Sachs. Hopf supplies the only really jarring note when, unfortunately, he loses pitch for a moment in his famous Prize Song.

FIVE DISCS IN ALL

There are five discs to the opera, which represents quite a sum. But of all these historic Bayreuth recordings, the Mastersingers would be my choice of all I have heard to date. The balance of the performance is good, and all sides play without any serious defects.

BEETHOVEN — Symphony No. 9 (Choral) Op. 125 — Coriolan and Egmont Overtures, played by the Residency Orchestra with the Amsterdam Toonkust Choir conducted by Willem van Otterloo. Phillips A 00145/146 L.

I was most impressed with this recording, because it fulfils most of the requirements for a really good performance of a colossal work. The pitfalls are many. It is long, the music requires great musical intelligence to understand and guide, its tempo must be firmly arranged or it will drag, it must be shaped from first to last or it will fall to pieces. And then there is that Waterloo of a final movement, where some of the most difficult vocal writing of all time is encountered.

William van Otterloo, the conductor, takes the whole symphony as a vigorous challenge, and sets his tempo accordingly. The result makes a striking contrast with Westminster's version under Scherchen, for instance, the latter presenting a much more sedate and introspecti picture, made the more so by t forward, analytical recording.

The Philips record isn't as brillia as the Westminster, in which t orchestra is almost uncomfortab close at times. The Philips orchest is further from the microphones a ties the performance together som what better. I don't mean that is a dull record—on the contra the balance is particularly good a the overall effect most convincir In addition, it is a very "safe" reco to play, with scarcely a blemish ev for wide-range gear.

BRISK TEMPO

I liked particularly the brisk tem in the second movement, in whi Otterloo far outpaces Scherche They both take the slow third mov ment at about the same speed.

The last movement I thought m successful. We rarely hear a quar of soloists which is beyond criticis but these are quite good, particula the baritone. The choir is commen ably free from that ear-rending ed which is the ruination of ma choral records. And the balan between orchestra, soloists and ch is very good indeed.

Hall reverberation is pronounc with the choir, but I thought added to the impression of spa essential for such a huge musi team.

The only thing I really did n like about these records were t breaks in the second and four movements. It's true these a hazards because of their length related to the playing time of o side, but others have avoided t breaks, and it's a pity, particula with such a work, that Philips ha not followed suit.

On the whole it is an impressi release, which will stand any amou of competition.

Both the overtures are of hi performance standard. This Re dency orchestra is a fine body musicians.

TCHAIKOWSKY. — Piano Co certo No. 1 in B-Flat Minor, play by Alexander Uninsky, with t Residency Orchestra, conducted Willem van Otterloo Philip A00135L.

The gramophone has not be kind to this concerto. Ever since t impact of the opening bars up the general populace was observ and exploited, we have heard it all versions at all times and plac Unfortunately, the work never w wear very well, and heavy repetiti has perhaps drawn attention u fairly to its threadbare garments.

It has, however, a great appe to many pianists, for many reason It has some extremely brilliant pa sages, particularly in the first a last movement. To performers su

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SONGSTER REG'D
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; Horovitz, they provide the means
r breath-taking impact and speed.
thers are attracted to the senti-
ental second movement. But most
ave a stab at both, and unless their
ility is well above the ordinary,
oduce very dull results.

The pianist here plays with fire
nd weight, both amplified by a
rward piano recording which most
mes dwarfs the orchestra altogether.
ut he has little flexibility; he
esn't get that flashing precision
ithout which the performance be-
mes cloudy and climax is reduced
mere noise. A more remote re-
rding technique would probably
ave helped matters here.

NO EXTREMES

However, it is a typical, lusty
erformance, and if it doesn't shine
ith the brightest, it avoids many
the shocking pitfalls into which
any fall.

Recording isn't full wide range,
nd is perhaps a little too heavily
t in a few places.

BEETHOVEN — Symphony No. 6
F major (Pastoral) played by
e Pittsburgh Symphony Orches-
a conducted by William Steinberg.
apitol CLC001.

Capitol have selected a particu-
rly fine recording for their first
ajor work issue in Australia. I
eard this record some time ago as an
merican pressing, and found the
cally pressed version equally as
od. The symphony is well enough
nown to pass without much com-
ent as such, for it is one of the
ost popular and probably the most
neful of them all.

Steinberg plays it fairly briskly—
fact the only major criticism is
at at times he could have been a
ttle more urbane and opulant. As
is, the performance is particularly
und, with plenty of weight and an
dequate flexibility.

The frequency range is not wide
y modern standards, but it is quite
tisfactory, with a good all-round
alance. It plays without any seri-
us blemish even on the heaviest
assages, although wide-range equip-
ent may pick up a few light
rackles here and there.

I would class it as the best all-
und version of the Pastoral I have
eard to date on LP.

GRAND CANYON SUITE

FERDE GROFE—Grand Canyon
ite played by the Capitol Grand
rchestra conducted by Ferde Grofe.
apitol CLC002.

Effective program music descrip-
e of the Grand Canyon, one of the
orld's mightiest spectacles. It is in
e movement — Sunrise, The
inted Desert, On The Trail,
nset and Cloudburst. The
les and the treatment are pretty
vious, but attractive. If I don't
ee that it will become an Ameri-
n classic, as the label tells me, it
ll, I am sure, continue to be popu-
with program builders for its
dy appeal and successful achieve-
ent in what it sets out to do. It is
rtain to be a steady seller, and this
cord could be the standard and cer-
nly authoritative version. It is
chnically good, well pressed, with
good surface.

MOODS FOR CANDLELIGHT
yed by Francis Scott and Orches-
, Capitol CLL002; MUSIC FOR
SY LISTENING played by Paul
eston and Orchestra, Capitol
L004.

As I see it, both these records are for easy listening, being made up of popular numbers such as Laura, How Deep Is the Ocean, I'll Get By, It Had To Be You, Intermezzo, &c., and are played by well-known popular orchestras. Just the thing for pleasant background. Both are well done, the recording is intimate and forward, the surfaces for the most part extremely good, and the over-all effect very smooth. They should both go well.

THE DESERT SONG SELECTIONS (ROMBERG)—45 rpm Extended Play. Capitol CEC-001.

The first of the 45-type records, this will be followed by others from Capitol. It is a pleasant disc, including the best-known numbers from this smash-hit of yesterday, numbers which, of their kind, have been equalled or excelled by few. The recording is quite good—vivid and forward, although the singing isn't quite in the celebrity class. Special grooving has extended playing time to about 7 minutes. The large centre hole requires a special insert to fit ordinary turntable, although by careful centreing the record can be played without it.

SYMPHONIC VARIATIONS

CESAR FRANCK — Symphonic Variations; SCHUMANN — Symphonic Studies, played by Moura Lympany and the Philharmonia Orchestra conducted by Walter Susskind. HMV CLP-1002.

A record which will be welcomed by all who know these two fine recordings in their 78 versions. There is, of course, little comparison in a musical sense between the two, if only because the annoying breaks have been eliminated.

The Symphonic Variations is one of the most popular of minor concert works and probably Franck's best-known composition. Simple in concept, it requires a special kind of musicianship to catch its unique atmosphere and changing mood. Moura Lympany is famous for her performance of it—I doubt whether there is a better version available at the present time.

The Schumann Studies are for piano alone and have been compared with the Carnival Suite, although I for one would not class them together. That is a matter of opinion, however, and without doubt the pianist is completely at home with music of this kind. The recordings are not new, but they are quite convincing in their new dress. The piano is heard cleanly, and the general balance is good.

WIDER RANGE

As a final note, what has happened to the wide range — really wide range — we were rather looking forward to with the modern LP? I'll admit there was something of a welter of cymbals and jingles in the first flush of quiet surfaces, but generally speaking, the latest LP's are not remarkable in this department. Many are no better than average 78 standard minus the scratch.

It may be that the task of processing too wide a range, with pre-emphasis, has proved too difficult in mass production. There are one of two exceptions in the wide range business, but I'll be most interested to see how it settles down in the next year.

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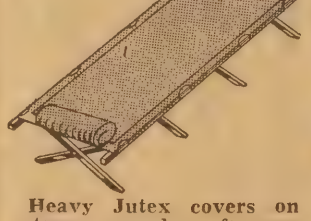

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ROM THE SERVICEMAN WHO TELLS

(Continued from Page 53)

lowever, any discomfort I may e suffered was amply repaid by jubilant air of my friend who ked as though he thought the id was a pretty good place after Actually I could claim little dit for the solution, for it was ely and simply a fluke and the ct explanation took some working

n order to appreciate fully what pened, it is necessary to consider electrical system of the car and radio gear. The radio is operated n its own battery in the boot of car but this is wired in parallel n the regular car battery mount- on the engine side of the bulk- d.

his allows each battery to be rged from the car generator and to contribute something to what- r loads are imposed on the sys- . In practice the resistance of connecting leads tends to iso- the batteries from each other far as heavy discharges are con- ned as, for example, when the ter is operated.

lowever, it is probable that the rent required to operate the trans- ter, when actually transmitting mething under 20 amps) is shared ly evenly by the two batteries. s means that a current of approx- tely 10 amps will be flowing ough the connecting wire between two batteries and also through chassis of the car. This last point most important.

requires only a simple knowledge Ohm's Law to appreciate that a gth of wire connected between two earth points of the batteries other words in parallel with the ssis) would also carry a portion his current, the exact proportion ending on the ratio of resistance he two conductors.

ow this is exactly what was hap- ng. The shielded braid on the rophone cable was acting as the luctor in parallel with the chassis thus carrying a portion of the ent from the front battery to the o power supply. This, in turn, ld cause a voltage to appear be- en the two ends of the shielded e and this voltage would be in s with the microphone.

ing pulsating in character, due e action of the vibrator, the cir- voltage would appear as hum he grid circuit.

lmittedly the proportion of cur- carried would not be great, or voltage developed across the l very impressive, but it would need to be in the order a few millivolts in order to ar as a high level hum in the ut. The position is further ag- ated by the fact that the peak nt in a vibrator supply would nuch higher than the average nt as indicated on a meter.

e important point about the e thing, from my point of view, at such a condition is not con- l to mobile VHF systems. Since portion involved was, after all, an audio amplifier, it could just sily happen in a vibrator-oper- PA system. A good rule, there- with such systems is to always the microphone cable at one only, the amplifier chassis, and sure it is insulated at all other s.

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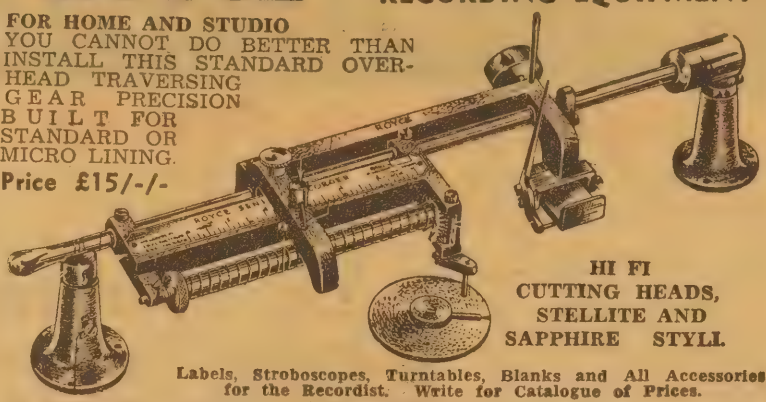

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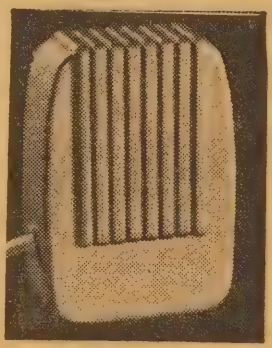

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SHORT-WAVE NOTES BY ART CUSHEN

HILVERSUM ADDS FOUR CHANNELS

Four new frequencies in the 19, 25, 31 and 41M bands have been put into service by the International Service of Radio Netherlands.

THE frequencies used to Australia and New Zealand include on 15425 Kc in the English service 7.45-8.25 pm, and 11950 Kc in the Dutch service from 7.0 to 7.45 pm. On Sundays the English service is not broadcast, and the Dutch service which replaces it, operates from 7.0 to 8.25 pm.

Reception on 15425 Kc is only fair, due to severe side interference from Radio France Asie, Saigon, on 15430 Kc until they close at 8.15 pm, and this leaves the last 10 minutes of the Hilversum program to be received very clearly.

The use of 11950 Kc in the Dutch service means that at present signals are only poor but during the peak of summer, reception on this frequency should be fair. A new 41-metre band frequency, 7210 Kc is used in the service to South-East Asia and Africa from 2 to 2.40 am. This frequency is also used in the Africa and Europe in Dutch from 4.0 to 6 am daily, and to 7 am on Sunday, as well as the new 9745 Kc outlet.

The complete schedule is: English: 7.45-8.25 pm, (5980, 11730, 15220, 15420); 2.0-2.40 am, (5980, 7210, 9590 15425); 7.45-8.25 am. (5980. 6025, 9590): 12.30-1.10 pm, (6025, 9590). Dutch: 7.0-8.25 pm, (Sunday) 5980, 11950, 15220, 15425, 17775); 7.0-7.45 pm, (weekdays), (5980, 11730, 11950, 15220, 15425); 10.30 pm-1.30 am, same frequencies also 17775 Kc; 4.0-6. am, (to 7 am, Monday) (5980, 7210, 9590, 9745); 8.30-9 am, (6025, 9590); 9.5-11.30 am, (6025, 9590). Spanish: 6.45-7.25 am, (5980, 6025, 9590); 11.45 am-12.25 pm, (6025, 9590); 1.15-1.55 pm, (6025, 9590).

HSK9 VERIFIES

HSK9, Bangkok, Thailand, confirms reception of the new 50 kw transmitter by a letter and card sent registered air-mail. In verifying, the Chief of the Overseas Broadcasting Division (Mr. Chamnong Rangsikul), asks for further reports, and encloses the latest schedule, which shows transmissions as: No. 1 General Overseas Service, 8.0-10.15 pm, with English news at 8.5 pm, and a program to Thai forces in Korea at 9.30 pm; Transmission 2 Home Service relay, 11 pm-midnight; Transmission 3 to North America 2.15-3.15 pm with news at 2.25 pm. All these broadcasts are on HSK9 which has made a frequency change to 11670 Kc from 11700 Kc. No mention is made of the 6001 Kc station which was in use when the new service was organised in June. The verification card shows a map of Thailand, with the outline of the city of Bangkok and the antenna tower of HSK9. The stations are now under the control of the Public Relations Department, and not the Publicity Department as formerly. The station is pleased to receive reports and will verify them promptly, without return postage being enclosed, states the Chief of the Overseas Broadcasting Division.

NEW VOA FREQUENCIES

Voice of America is using several new frequencies in its worldwide service. A new frequency, outside the usual bands, is used by Munich-12, using 5275 Kc from 2.15 to 8.15 am. Another new station operating is Okinawa, on 7160 Kc, which is now on regular schedule, 8 pm-12.45 am, after testing for several weeks. Philippines-1, a further new station, in Northern Luzon, is at the site of the new million-watt transmitter on broadcast band, and should not be confused with the Manila relays.

The Luzon transmitter operates on 11700 Kc, 8 pm-1 am. The Voice of America has reduced its overseas language broadcasts from 45 languages to 34. The Voice of America and the other United States Information Services have made reductions in their services. New BBC transmitters relaying the VOA programes include MCS (7110) 5.30-6.0, 6.30-7.45 am; GVV (11730) 12.15-12.45 am; GWQ (11840) 12.15-4.30 am. The Voice of America's Ceylon relay base at Colombo, with transmitters at Ekala, now has two transmitters in operation, Colombo-1 (11875) 11.30 pm-3.30 am, and Colombo-2 (9570) 9.30-11 pm, 11.30 pm-3.30 am.

TOKIO DROPS 1178 Kc

Radio Japan, which for the past two months has been using 11780 Kc as reported in the October issue, has dropped the use of this frequency in favor of 11725 Kc as its 25-metre band outlet. When pointing out that 11780 Kc was used extensively by Radio New Zealand, the Chief of the International Broadcast Section of NHK in Tokio, stated that the frequency was used by Tokio before the war, and when the short-wave service was again established as Radio Japan, the Berne frequency assignment office gave the NHK use of 11780 Kc without any restrictions on time of use of the frequency. The change to 11725 Kc means that Radio New Zealand has again a fairly clear frequency for reception in Australia.

Tokio has been sending selected listeners graphs to be filled in, covering reception of their overseas broadcasts. They use the SINPO signal listing, which is Signal Strength, Interference, Noise (Static), Propagation and Overall Rating. The signal readings are given in the 0 to 5 rating, and this gives the engineers a very detailed report on not only the signal strength, interference, but overall conditions prevailing when reception was monitored.

The details listed on the graph are very similar to those on the BBC's monitoring graph sheet except that, in the case of Radio Japan, only details on the signals are recorded. No actual graph is plotted over a period up to four hours as in the case of the BBC's monitoring sheet.

NOTES for the next issue to 212, Earn Street Invercargill, New Zealand. All times used are Eastern Australian Standard Time.

We would like to sincerely thank all our many readers for their letters of appreciation over the past year, and trust that over the coming holiday period, and during 1954 they will enjoy many more hours fo happy listening.

LATEST JAP SCHEDULE

Radio Japan's latest schedule, over the 50 Kw transmitters, is effective to Feb. 28th, 1954, is as follows:

North America.—3.0-4.0 pm: JOA3 (9695), JOB2 (7180).

Hawaii.—5.0-6 pm: JOA3 (9695), JOB6 (11725).

Australia.—7.0-8 pm: JOA3 (9695), JOB2 (11725).

China-North China.—9.0-11 pm: JOA3 (9695), JOB2 (7180).

Philippines - Indonesia. — 11.30 pm-12.30 am: JOA3 (9695), JOB6 (11725).

Indo-China, Burma.—12.45-1.45 am: JOA3 (9695), JOB2 (7180).

India-Pakistan.—2.0-3 am: JOA3 (9695), JOB6 (11725).

Europe.—5.0-6 am: JOA (6069), JOB2 (7180).

South America.—8.0-9 am: JOA3 (9695), JOB6 (11725).

FLASHES FROM EVERYWHERE

SAO PAULO ON 11925 Kc.

"Radio Bandeirante" Sao Paulo, Br is putting an excellent signal during afternoons on 11925 Kc. This new stat which relays medium wave PRH9, is signed the call ZYR7, but the call-s are very seldom broadcast. The slo is heard on the hour, and the prog consists of many English recordings. frequent singing commercial annou ments, and is heard till closing at 3.30 Sao Paulo is one of Brazil's most gressive cities, its population having creased by over a million in the ten years. "Radio Bandeirantes" can be tuned during the late evening and been logged at 8 pm, with some inte ence from HCJB on 11915 Kc.

ISRAEL is at present conducting perimental broadcasts beside the op tion on 9000 Kc. The tests are b beamed in various directions and wil broadcast on 7190 Kc and during Dec ber to the 12th on 9745 Kc. Each the test will be in a slightly diffe direction and listener reports are requ ed, giving reception over several d during which time a change of direc in the aerials would have been m English news is carried at 6.15 am, an good on 9000 Kc. As we go to p the test on 7190 Kc is being heard, interference is severe on the freque

PEIPING has added a new aftern transmission at 1 pm and using the l frequency assigned—11960 Kcs, as we 15060 Kc, with a broadcast in Eng Peiping's full English transmissions 1 pm on 11960, 15060 Kc. 7 pm on 6100, 9040, 11690, 15060 and 15170 (this is ally 15130 Kc), and at 11.30 pm on 15060 Kc.

PRAGUE'S new 41-metre freque 7255 Kc is used to North America at am, and though reception is not pos at this time, the frequency is expecte be on the air during earlier broadc This frequency is assigned the call OL but in the case of Prague transmiss the call-signs are seldom used for quency announcements. Prague also 9550 Kc in the second North Amer broadcast at 2.5 pm, reception on this quency being fair in New Zealand, not possible in Australia till at least March.

HCJB's broadcast of December 1 6.30 pm will feature recorded organ m played by Ken Boord, well-known sh wave editor of Radio and Telev News. The music, recorded by B at his home in Morgantown, W.Va., be flown to HCJB and presented several broadcasts directed to liste throughout the world. HCJB by then be using the new 100 Kw transmi and the antenna beamed to Europe the South Pacific, loca'ed at HCJB's home at Pifo, outside Quito, will als used. The special broadcast for area is being broadcast on 15115, and 9745 Kc. HCJB's present sche is, 6050 Kc, 8.40 pm-3 pm; 9745 Kc, 3 am; 11915 Kc, 10 am-midnight; 1511 3 am-1 am; 17890 Kc, 3-10 am

BULGARIA'S new 41-metre transmi on 7255 Kc, replaces the 6070 Kc o and carries the English broadcasts listeners in Europe at 6 am, 7 am 8 am. The service is still carried on 7670 Kc relay station, which is of l power, though much easier to tune, to the severe interference experienc the 41-metre band outlet.

UNITED NATION'S broadcasts from Information Centre in Geneva, has verted back to 6670 Kc for the trans sion 4.15-4.30 am in French and Eng after using 9535 Kc for some weeks.

EGYPT'S new 100 Kw transmitte being received at good strength on eral frequencies and a report from US lists the use of 17725 Kc in a sc to India from 11.57 pm. Cairo is st on 6085 and 11965 Kc at 2.30 pm.

THE HAM BANDS WITH BILL MOORE

DX contests provide considerable interest among amateurs. The British Empire Radio Union Contest conducted annually among Empire radio amateurs is very popular. Propagation conditions do not allow the amassing of the record scores of a few years ago, but interest is still maintained especially amongst stations in the British Colonies.

IE 1954 BERU contest will be con-ducted in late January and if propa-on conditions follow those of this r, the date should be more suitable n a DX angle than March/April.

number of major alterations have n made in the new rules. Firstly, the ephony section has been abolished. oduced a few years ago it was never supported.

the 1953 contest, 105 logs were re-ed for the CW sections senior and ior, while only 21 logs were listed he Telephony section. The odd com-ncing times for various areas, and the cted operating period of 24 hours e too been eliminated, a straight out rating period has been included—the od 48 hours.

ne contest is always well supported ensures entrants of some interesting tacts.

LES

ne following is a summary of the s:—

ne event will be divided into Tele-phy sections.

a. Senior (maximum licensed power).
b. Junior (maximum input 25 watts).

ne event (senior and junior) will take e from 0001 GMT, Saturday, January to 2359 GMT, Sunday, January 31,

ne contest is open to all British sub-s in the British Empire and man-d territories, also British servicemen ccupation forces. Entrants must be nbers of the RSGB or British Em-Societies. (WIA in Australia, NZART New Zealand.)

on RSGB members should declare the log that they are fully paid up nbers of their national society.

nly the entrant is allowed to oper-his station during the contest.

gs should be made out on quarto or scap paper. Sheet one will bear the e, address, &c., and declaration, sheet the scoring anaylsis and continuation ts the log in order. (GMT.)

l entries forwarded should be post-ked not later than February 15, and to RSGB Contest Committee, New cin House, Little Russell St., London,

eration is limited to the 3.5, 7, 14, and 28 Mc/s bands. Transmissions be CW only, and frequent reports T8 or less may result in disquali-ion.

Contacts may be made with any stations using a British Empire call sign or occupied territories call sign, but not with stations in the entrant's own zone. Only one contact per band with each station will count for points.

For each zone (outside the competitors own) the first contact on a specific band will count 15 points, the second con-tact 14 points, and so on unfil after the 14th contact they count one point each. The system will be repeated on each band.

For entrants outside the British Isles, Zone 2 is subdivided into three zones under call sign figures. (a) Call signs with figures 2 and 4. (b) Call signs with figure 3 and (c) Call signs with figures 5, 6 and 8. For example, Stations G3, GC3, GD3, GI3, GM3, and GW3 are all in Zone 2B.

Serial numbers must be exchanged and acknowledged before a contact can count for points. Serial numbers shall consist of the RST report plus three figures commencing between 001 and 100.

The following are the 24 prefix zones, No. 2 being subdivided into three sec-tions for entrants outside the British Isles (see rules):—

1.—AP, VU, 4S7 (Ceylon).
2.—a—All G prefixes with figures 2 and 4. b.—All G prefixes with figures 3. c. —All G prefixes with figures 5, 6 and 8.
3.—DL2, ME9. 4.—MD, MF, ZB, ZC4, 5A2C. 5.—VEI, VO.
6.—VE2. 7.—VE3. 8.—VE4, 5, 6.
9.—VE7, 8. 10.—VK2, 4. 11.—VK3, 7.
12.—VK5, 6. 13.—VK9, VR4. 14.—All VP except VP8. 15.—VP8, VK1.
16.—VQ1—5, ZD6, ZE. 17.—VQ6, 8, 9, VS9, MP4, ST, ZC2 (MI3).
18.—VR1, 2, 3, 5, 6, ZK, ZM.
19.—VS1 to 6. 20.—All ZD except ZD6.
21.—ZL. 22.—ZS1, 2. 23.—ZS3, 6, 9.
24.—ZS4, 5, 7 and 8.

The entry form (sheet one) should in-clude following information: Call, Sec-tion entered, Name, Address, Input, Aerials used, Declaration duly signed that the rules were followed and that the decision of the RSGB Contest Committee is acknowledged as final, also if applic-able, that entrant is a member of a BE society.

Sheet two should show the zone ana-lysis, contacts made on each band and points claimed with the various zones.

Further sheets comprise the log and should list in order, Date, GMT of con-tact, Band, Station worked, Serial Nos. sent and received, points claimed.

RADIO IN CARIBBEAN EXPEDITION

9AA is the call sign of the Motor it Xarifa which left Hamburg in ust for the Caribbean, and will later through the Panama Canal and pro-to the Galapagos Islands. The ex-tion is led by Dr. Hans Haas, fam-German underseas photographer.

9AA is a special call allocated by German Post Office, and as the ship es no standard radio equipment, the means of communication with shore be via amateur stations.

e main transmitter built by members ne DARC (German National Society) FO controlled, and runs 100 watts on 3.5 7 and 14 Mc/s bands. A separate smitter is used on 28 Mc/s.

thur Milne, G2MI, requests that ama-s throughout the world listen for A, and to be ready to assist the dition should the necessity arise. Gen-y the station will operate on 3520 and Kc/s for CW, and 3700 and 14150 for telephony. English-speaking eurs are requested to speak slowly Morse speed should be restricted to ords per minute.

The station at no time will be oper-ated from land so contacts will be of no value for DXCC claims.

Radio amateurs can provide valuable assistance to the expedition in the com-munication field.

The RSGB's low power Field Day, con-ducted in September, included a number of interesting features. Firstly there was no specific power input limit, the power being regulated by the weight of the equip-ment permitted to be used. The total weight of the gear was restricted to 20lb, and the following items, if provided, must be included in this weight: receiver, trans-mitter, power supplies batteries, head-phones, key, frequency meter, aerial wire, insulators, earthing device and spares—in fact, all radio and electrical apparatus and accessories taken to the site.

Operation was restricted to CW on the 3.5 and 7 Mc/s band, and each contact in-cluded an exchange of RST report and QTH.

The duration of the contest was seven hours and equipment had to be independ-ent of the electrical system of any vehicle or of any mains supply.

TVI REGULATIONS

The FCC have finally listed regula-tions covering the TVI caused to IF channels in the older type TV receivers in the US which are aligned to a fre-quency near 21 mc/s.

Years before the 21 mc band was granted for use under Atlantic City allo-cations, this frequency was used exten-sively for IF channels, and TVI has con-stituted a considerable problem.

The FCC officially recognises that this type of interference is primarily caused by the design of the TV receiver. In many cases such interference can be cured by simple and inexpensive means; and co-operation with listeners would be appreciated. The Commission expects that amateurs will determine the type of interference occurring and make sure that their transmissions comply with the regulations.

The Commission, however, cannot hold licensees operating in the 21 mc band responsible for remedying such IF in-terference if the regulations are com-plied with.

They also give due credit to the TVI committees (over 300 in number) oper-ating throughout the country for the work performed. These committees com-prise set-owners, industry representa-tives and amateurs, and have done much to alleviate TVI, and it is hoped they will solve some of the 21 mc IF TVI prob-lems.

QSL CARDS

It seems a pity that the long-recognised habit of exchanging QSL cards after original contacts is falling into disuse.

Stations who send out cards for all contacts at the moment seem to obtain not much more than a 25 pc return. In the past, cards were exchanged for con-tacts even over the back fence. Perhaps that is carrying the subject to the ex-treme, but it was generally accepted that the contact was not complete until cards were exchanged.

Business at QSL Bureaux is very quiet, and cards handled only cover a small percentage of those passing through a few years ago.

Perhaps the greatest contribution to this state is the common habit these days of forwarding a QSL only after one has been received. It readily will be seen, if every station adopted these tactics, no cards would be exchanged. The greater use of telephony, with the more per-sonal touch, probably has also some bear-ing in the falling-off in the cards ex-changed. Stations in contact soon learn of each other's equipment, habits, &c., and feel no further confirmation is re-quired.

If it is generally considered that QSL-ing should remain an integral part of amateur radio, more of us should QSL all con-tacts and improve the Bureau business.

AMATEUR CONVENTION

The South-western Zone (NSW) Con-vention, held at Wagga on October 31 and November 1, was attended by 50 per-sons, including a number of VK3 visit-ors. A full program was enjoyed by all and many excellent prizes won. Credit for the organisation should be given to the committee, comprising zone officer Jim Edge, VK2AJO, VK2AID, VK2BW, VK2PN, VK2PL, VK2RS.

Winner of the 7mc Scramble was Stan Mitchell, VK2AID, who contacted 19 sta-tions in the set period. Neville Stilwell, VK3ACN, and Ross Weeden, VK2PN, tied for second place with 18 stations worked. A blackout in Wagga for the final 15 minutes of the contest (operation from AC was permitted) caused some conster-

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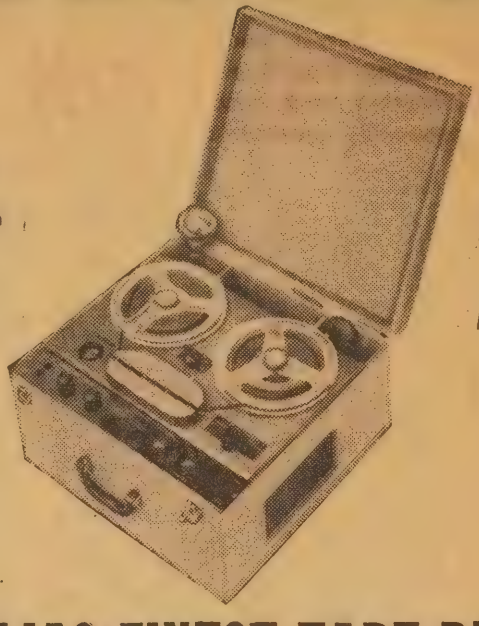

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ıtion while the battery-operated com-·titors gained some extra contacts.

The 144 mc hidden transmitter search as won by Western Zone competitors ugh Stitt, VK2WH, and John Meagher, K2AMV; second, Geoff Page, VK2BQ. ıe location of the hidden transmitter as well selected, five miles out along e river valley and, with only one bridge, ou had to be sure which side of the ver to venture along.

The 3.5 mc search proved too much for e three competitors, but they managed divide the prizes.

Geoff Page, VK2BQ, identified all opera-rs on the recorded "Pick the Voices" mpetition and won a suitable prize.

Zone conventions will be held annually various centres in the zone.

Mr. G. Riley, of the Wireless Branch, MG's Department, was present at the ctober meeting of the NSW division, ·ld at Science House, Sydney, when he terpreted and explained a number of gulatory problems. He specially review-l the operation of the "advisory com-ittee" and the election of members. He id amateurs nominating for positions ıould be the most experienced available.

r. Riley stated reports sent out by the mmittee were for the guidance and sistance of amateurs, and the informa-on given by the lecturer was greatly ppreciated by members.

VIA EVENTS

The dates of future NSW WIA events ·e: Dec. 9, division's Christmas party; ec. 12, Hunter branch's Christmas party; ın. 23, NSW Division's annual hamfest a pavilion in the Sydney Showground.

The Gladesville Radio Club will con-uct their Christmas party at Fairyland easure grounds on December 11. As the ub's activity is centred on the higher equencies, the VHF gang were invited.

The NSW Division UHF section's ini-al nocturnal 144 mc hidden transmitter arch, held on November 4, proved very ppular, 10 parties participating.

The transmitter, manned by John Mil-r, VK2ANF, Wally Webster, VK2EW, and Griffiths, was located beside the Trig. ation at Duffy's Forest, north of S d-y. The trig was decorated with a hur-ane lamp to guide the parties home. rst party to locate the transmitter was o Meyers, VK2KS, and Jack Langley, K2AGT; time taken, 45 minutes. Second rty was led by Dave Andrews, VK2AWZ. espite blind roads, rubbish-tips, rain d other hazards, all parties arrived to rtake of supper. It appears this event ill be the forerunner of many similar ening searches.

The 50 mc/s band opened for inter-ate working in NSW in early Novem-r; on numerous occasions VK4 stations far north as VK4NG, Rockhampton, ere audible. Openings to VK5 and VK6 curred on three consecutive evenings. K2RU, of Gosford, and VK2TA, of Young, ere among the few stations operating. ıe band will soon be busy with the rious stations there for the DX season.

The Russians seem to have extended eir amateur radio activity in recent onths. On 7 mc's in the mornings a mber of them can be heard working ıer Europeans and W. stations. Per-ps they are club stations who are owed to contact stations in other coun-es, but the call-letters did not include e usual KAA of the clubs. On 14 mc/s stations from the USSR call WSEM, ıich appears to be a request for re-rts, as they do not contact one an-ıer.

The 14 mc/s band treated Telephony mpetitors in the VK/ZL DX contest rly well. Although propagations con-ions in the afternoon were poor, even-gs provided some excellent European gnals, G's running well over S9. A mber of stations amassed good scores. XW8AA has been active from Indo-ina around 2100 hrs, 14,050 kc/s. His H, c/o Radio Station, Vientiane, Laos. 8 has been the prefix for Indo-China date.

YOUR OPPORTUNITY

join the world-wide ranks of amateur nsmitters! The Wireless Institute of stralia holds regular classes in Sydney assist Sydney and suburban enthusiasts obtain their Amateur Operator Certi-e of Proficiency.

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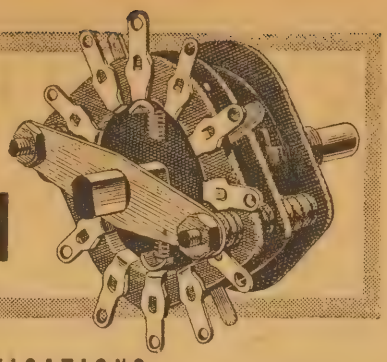

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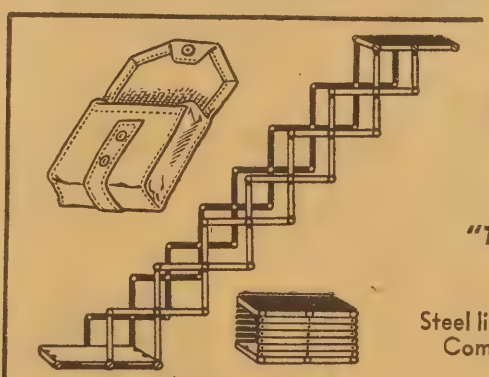

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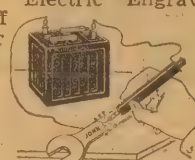

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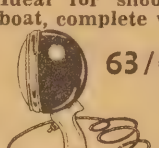

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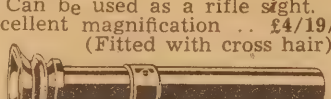

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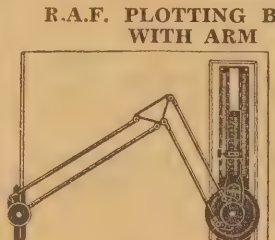

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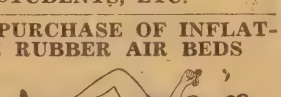

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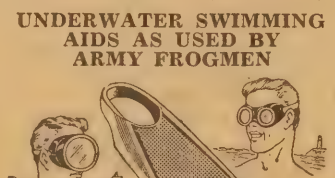

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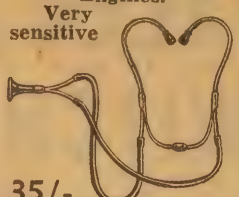

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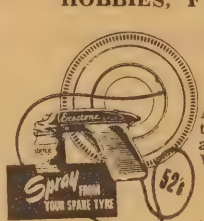

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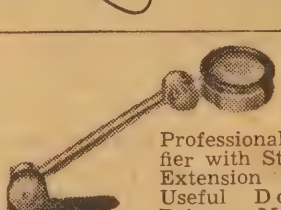

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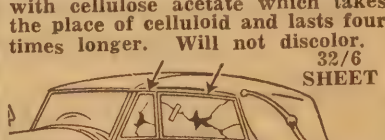

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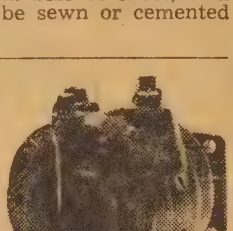

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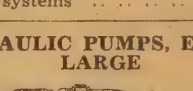

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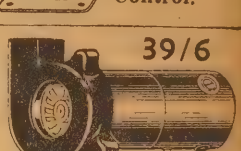

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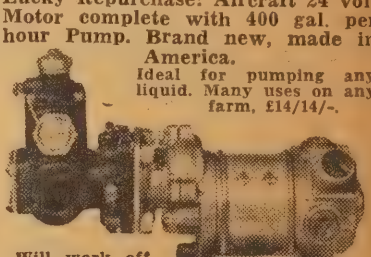

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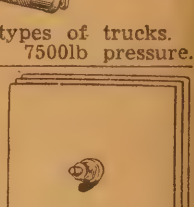

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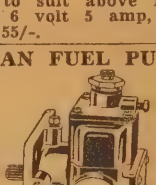

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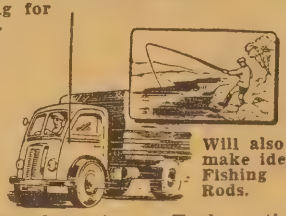

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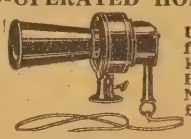

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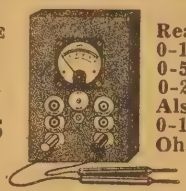

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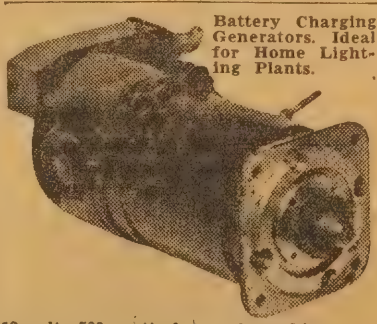

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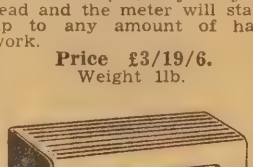

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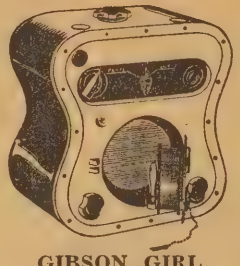

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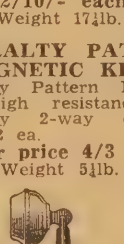

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Our price 3/6 ea.
Weight 2lb.

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EXTRA SPECIAL; Few only; Lifeboat Transceivers Type TBX2. Made in U.S.A. in 1942.

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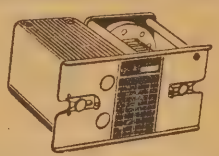
Receiver covers 2000 to 8000 KC.
Transmitter covers 2000 to 4525 KC, and has two crystal-controlled frequencies. Valves used are 4—34, 1—1C6, 1—837.
Dry Batteries to work receiver are not included but are standard dry batteries obtainable anywhere. These transceivers and equipment are worth easily £100, but we are selling them for **£40 each.** Weight 195lb.



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Our price 2/- ea.
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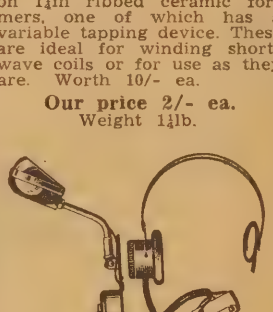

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HOW TO ELECTROPLATE AT HOME

Most readers, at some time or other, have wished they could electroplate for themselves the products of their workshop. In this article, the author explains the principles of electroplating, how to go about it and reasons why initial attempts often fail.

HERE are many reasons why such a coating may be advantageous. reasons of mechanical strength ease of working, the two metals st commonly used in engineering iron (including steel) and brass. oth iron and brass are subject to ck by the atmosphere. In the e of iron, rusting occurs, while he case of brass, tarnishing spoils appearance of the article.

lectroplating iron and brass with coating of some suitable metal, h as nickel or chromium, pre- ts tarnishing and provides a sur- e of permanent and attractive re.

n the case of car lamp reflectors, coating serves another purpose. reflector is easiliy spun from ss, but brass tarnishes rapidly , added to this, has a yellow or.

olored objects possess their color virtue of the fact that they ab- certain wavelengths from white t; thus colored objects do not re- t all the light which falls upon m. By coating brass with a ite" metal, a higher proportion he light is reflected and the re- tor is made more efficient.

ATING METALS

he metals commonly used for ing reflectors are chromium and v e r. Whether electroplating utifies an object is a controversial ject with which I am not going to l here; some readers may hold opinion and others another.

here is one charge, however, that not be laid against electroplat- and that is that it covers slip- d work. If anything, the very erse is true, for the effect of plat- a roughly-finished article is to ig out all its deficiencies.

n order to understand the theory electroplating, it is necessary to w a little about the atomic cture of the elements.

he full theory of this structure omplicated, and so, in the fol- ing paragraphs, I have attempted evelop a simplified version which ers just the ground that we re- e.

very material thing in the uni- se is built up of an enormous ber of minute particles which call atoms. The atoms them- es are built up of three types xtremely small particles, known rotons, neutrons and electrons.

OTONS

he proton is a relatively large icle which possesses a unit posi- electric charge. (The significant d here is "relatively", since the al mass of a proton is approxi- ely 0.00000000000000000000000017 ns. There are about 28 grams oz.)

he neutron is a particle which is pproximately the same mass as a proton but which possesses no electrical charge.

The electron is an extremely minute particle (about 1/1800th of the mass of a proton), possessing unit negative electric charge.

Now the atom is electrically neutral and therefore must contain an equal number of unit positive and unit negative charges, or, to put it another way, an equal number of protons and electrons.

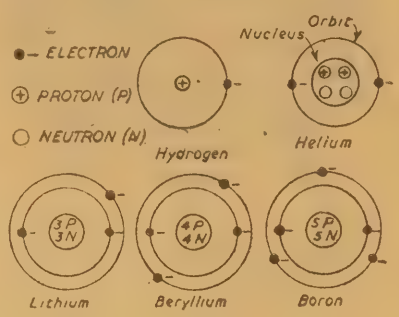

Fig. 1.—Diagrams illustrate the structure of the atoms of a few of the elements.

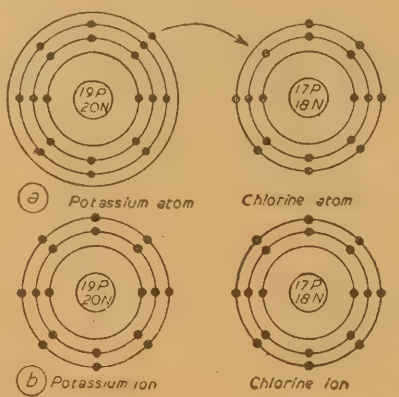

Fig. 2—(a) Diagrammatic representation of atoms of potassium and chlorine. (b) Ions of potassium and chlorine formed by the transfer of an electron from the potassium atom to the chlorine atom. (Note that the ions have eight electrons in their outermost orbits.)

The positive charges, or protons, are clustered together in the centre of the atom together with a certain number of neutrons, and this cluster is known as the nucleus. Around the nucleus revolve a number of electrons equal to the number of protons in the nucleus.

These electrons revolve in well defined paths, or orbits, about which more will be said later.

The simplest atom is one which has one proton and one electron. This is the atom of hydrogen. In Fig. 1 are shown the atoms which result by taking first one then two, then three protons, and so on. It will be noticed that in the nucleus of all the atoms, except that of hydrogen, there appear a number of neutrons.

If it so happens, that in the atoms illustrated in Fig. 1, the number of neutrons is the same as the number of protons, this is not necessarily always the case.

In the case of the element lithium, it will be seen that the extra electron takes up a new path, and that we now have two orbits. Each additional electron enters the second orbit until there are eight electrons in this orbit, and then a third orbit is started.

CHEMICALLY INERT

It is an interesting fact that the elements with eight electrons (or an octet) in their outermost orbit are all chemically inert; that is to say, they do not join with other elements to form compounds.

There are two main classes of compounds, electrolytes and non-electrolytes. It is the electrolytes with which we are concerned in electroplating, and the theory which follows is confined to this class of compound.

The atoms of active elements, in combining to form compounds, either give or receive electrons so that the outermost orbit possesses a complete octet.

In Fig. 2a the atoms of potassium and chlorine are shown diagramatically. It will be noticed that the potassium atom has one electron in its outermost orbit, and the atom of chlorine has seven electrons in its outermost orbit.

When potassium and chlorine combine to form potassium chloride, each potassium atom gives one electron to each atom of chlorine, as shown in Fig. 2b. Each potassium atom is now left with a complete octet and each chlorine atom also possesses a complete octet.

CHARGED ATOMS

There is a very important outcome to this change, however. If the charges at the centre (the protons), and the charges in the orbits (the electrons), are balanced, it is found that the potassium atom now has an extra unit positive charge, and the chlorine atom an extra unit negative charge.

Thus, potassium in potassium chloride is not in the form of a positively-charged atom, and the chlorine in the form of a negatively charged atom. These charged atoms are known as ions ,and have very different properties from uncharged atoms.

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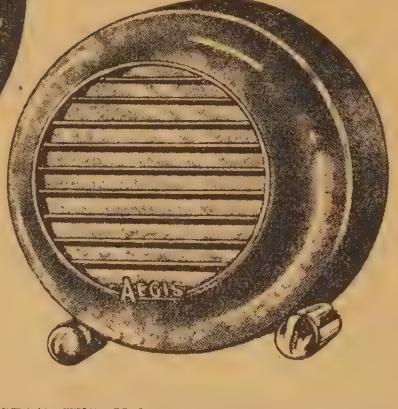

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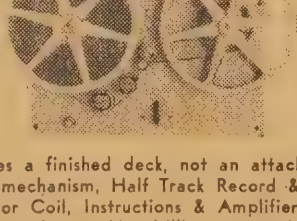

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A positively charged atom known as an anion, and a negativ charged atom is known as a cati Since the ions of potassium a chlorine are present in equal quan ties in potassium chloride, th charges cancel each other, and net result is that the potassi chloride has no charge.

The above theory can be appl to any electrolyte, and it theref follows that any electrolyte can divided into two sets of partic anions carrying a positive cha and cations carrying a negat charge.

IONISATION

When an electrolyte is dissolved water it breaks up (or ionises) i its constituent ions (to a greater lesser degree). Since these io carry electric charges they are c able of carrying an electric curre Thus, solutions of electolytes conductors of electricity.

It is now necessary to consider nature of an electric current. electric current may be regarded a flow of electrons through a w or other conductor. A battery generator can be considered to b pump which promotes this flow.

The direction of the flow is fr the negative pole of the batte through the circuit and then ba to the positive pole. (This is in opposite direction from the conve tional direction of flow of an el tric current, i.e., from positive negative. This is because the co vention was decided before true nature of electricity had be established.)

Fig. 3a is a diagram showing flow of electrons through a circ If we replace the resistance of F 3a by a vessel containing an el trolyte, leading the current into a out of the electrolyte by means metal plates, we get the arran ment shown in Fig. 3b.

The metal plates which are us to introduce the current into t electrolyte are known as electrod The electrode connected to the neg tive pole of the battery is called t cathode, and that connected to t positive pole is called the anode.

I have shown that the solution an electrolyte contains charged pa ticles, the ions. The effect of pa ing an electric current through electrolyte is to cause the electr positive ions or anions to move t ward the cathode where they rece an electron, so converting the i back into a free atom.

The cations, on the other han move toward the anode where th are discharged and converted in atoms, their spare electrons bei absorbed into the circuit.

METALLIC DEPOSIT

It is thus possible to deposit t electro-positive or metallic part the compound on the cathode, t electro-negative part being deposit on the anode.

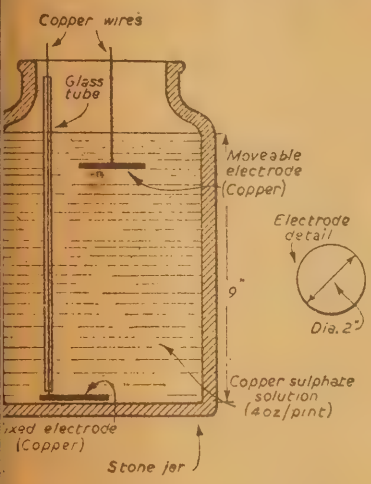
By a suitable choice of electroly and by using the same metal for t anode as is present in the compoun it is possible to ensure that the el ment or group set free at the ano attacks the anode and dissolves it the form of ions. Thus the streng of the solution is maintained a metal is effectively transferred fro the anode to the cathode.

This is the principle of electr plating, although for practical re sons certain departures are ma from the simple theory outlin above.

To be effective, the deposit of the tal used for plating must possess tain properties. It must first be form. This condition is obtained placing the article to be plated as cathode between two anodes, or, certain cases, by making ar- gements for the rotation of the icle during the plating operation. Secondly, the deposit must have od adhesion with the article being ted. In order to obtain this con- ion, all surfaces to be plated must scrupulously clean and free from ase. Details of the process in- ved in cleaning and preparing for ting will be given later.

The third desirable property is a posit which is already in a highly ished condition, or one which can worked up to a high polish. This t property is one which is most ficult to obtain, as the nature of deposit depends on a number factors.

The solutions used are not merely utions of simple salts, but are utions to which other chemicals, ich play an important part in the



ig. 4. — Circuit resistance. Variation f the resistance is obtained by alter- ng the position of the movable elec- ode. Some simple arrangement for aintaining the electrode at the re- uired height should be adopted.

cess, have been added. The tem- ature of the plating solution is also importance, different types of de- it being produced by solutions at erent temperatures.

nother important factor is the rent density. This is the current ving per square inch of surface a of the cathode. Beside these tors, others, such as the ratio of de area to cathode area and the ngth of the solution, play their ts.

good deal of research has been de on these factors enumerated ve, and the result has been a es of formulae and technical de- s which makes successful electro- ting a practical possibility.

The apparatus required to electro- te successfully in the home work- p depends on the size of the ar- e to be plated. In general, the er the article, the more compli- d and expensive becomes the ap- atus needed.

or small articles, such as the del engineer might requre to troplate, the apparatus can be sonably inexpensive and uncom- ated.

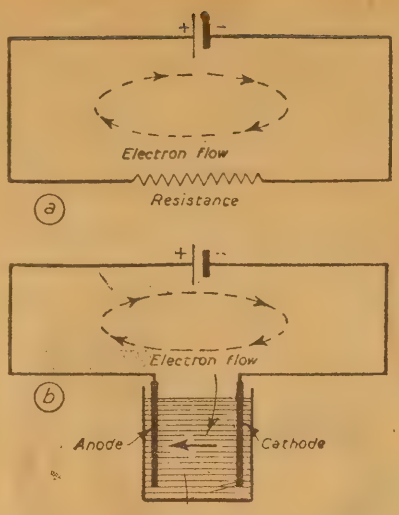


Fig. 3.—(a) Electron flow in a simple circuit. (b) Electron flow through an electrolyte.

A glass beaker, such as is used in a chemistry laboratory, makes a most convenient plating vat for small articles. These beakers can be obtained in a variety of sizes from any laboratory suppliers or chemists and are not expensive.

Since the plating solutions are used hot, a beaker made of heat-resisting glass should be chosen.

A thermometer which has the scale engraved on the stem is necessary. There are many types to choose from, and one should be selected which can be read easily.

TEMPERATURE SCALES

Two temperature scales are in current use, the Centigrade and the Fahrenheit, and for this reason temperatures will be give on both scales. The thermometers should read from 0 deg. C.-110 deg. C. in the case of the Centigrade scale, and from o deg. F. - 250 deg. F. in the case of the Fahrenheit scale.

Suitable instruments can be purchased from advertisers in this journal. Two instruments are normally used, a voltmeter and an ammeter. Of these, the ammeter is the most important, and, indeed, for simple work the voltmeter is not essential. The amateur is advised to dispense with the voltmeter.

The ammeter range depends on the type of plating and the surface area to be plated. For most small work an ammeter reading up to 5 or 10 amps is suitable, but if large areas are to be plated, instruments reading up to 30 amps may be necessary.

It is possible to purchase an instrument which can be converted to the required scale by adding simple resistance as shunts.

The circuit resistance is capable of variation so that the current flowing in the circuit can be controlled. The resistance should be variable be- between about 0 and 15 ohms, and should be capable of carrying the maximum current to be used.

Readymade sliding resistances are available, but they are expensive, and the reader is advised to construct one as shown in Fig. 4.

For small work, an ordinary six-volt dry battery gives quite satisfactory results, but it is preferable to use a bank of three accumulators, which have the advantages of being able to deliver a much greater current and of being recharged. A six- or 12-volt car battery, if available, is admirably suited for the operation.

Some simple switching arrangement, capable of making and breaking the circuit at the particular current value used, is necessary.

When the current is below 5 amps, a knife switch of simple design is satisfactory, but for higher current values a switch designed to make and break at that value should be used. (Of course, there is no objection to using a switch designed for 30 amps to break a circuit carrying 2 amps.)

SPECIAL SWITCH

A low-voltage switch of the required type can be obtained from a dealer in car accessories.

The various chemicals used in the processes will be detailed under the appropriate headings.

A quantity of connecting wire (copper, 16 gauge) and a few crocodile clips are necessary for setting up the circuits. A pint measure will also be required for making up the solutions.

The golden rule of electroplating is that the quality of the plating can never be better than the surface finish of the article being plated.

Every care should be taken, therefore, to obtain as fine a finish as possible. All tool marks must be removed by the judicious use of emery paper or a buffing wheel.

During its manufacture, the article will inevitably have picked up an uneven layer of grease. This layer, being normally quite thin, has very little effect on the appearance of the finished article, but when we come to plate the article, the grease, being a non-conductor, will prevent

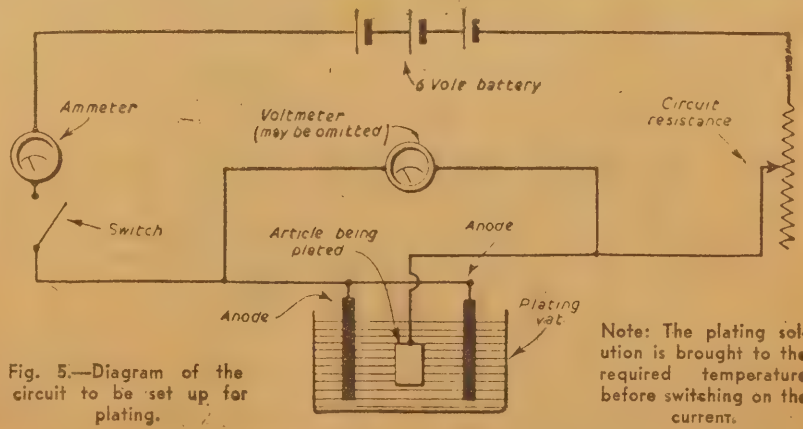


Fig. 5.—Diagram of the circuit to be set up for plating.

Note: The plating solution is brought to the required temperature before switching on the current.

the flow of electricity at various points and thus prevent the formation of an even coating of the plating metal.

Moreover, when plating does occur, there will be poor adhesion with subsequent peeling of the plating. An oxide layer will produce the same effects, and it is important to ensure that once the article has been prepared it is plated without delay.

In order to degrease the article, it should be immersed in a hot solution of caustic soda for about five minutes. The caustic soda solution can be prepared by dissolving two ounces of caustic soda in one pint of water. A glass vessel should be used as a container for the solution.

The article is then rinsed in clean water and immersed in a dilute acid. Sulphuric acid is used for the treatment of iron and steel articles, and nitric acid for articles of copper and brass. The dilute sulphuric acid is made up by diluting 1oz of concentrated sulphuric acid with three pints of water, and the nitric acid by diluting 4oz of concentrated nitric acid with three pints of water.

[WARNING: It is important to note that the acid must be added to the water, and not the water to the acid. Stir well when carrying the addition.]

The time of immersion should between one and two minutes. further rinse in clean water lows, and the article is then give final polish with a damp c charged with pumice powder.

After these operations, the art is given a thorough wash in runn water and transferred immedia to the plating bath. It should be dried between degreasing plating.

During the degreasing opera the article should not be touched the fingers. It is an easy matte bend up a simple pair of tongs f wire or strip, and these should used to handle it.

The apparatus is set up as sh in Fig. 5 (the voltmeter being omi if not available). The vat is fi with the plating solution at a t perature a few degrees above given (in order to allow for coo during the operation). The solu can be heated by placing the va a saucepan of water over a fire

USING BUNSEN

A more convenient arrangemen to heat the vat directly, by stand it on a wire gauze placed on a pod, and heating with a bun burner. In this way, a greater c trol over the temperature of solution is obtainable.

The surface area of the articl obtained by direct measurement (should be done before the degrea operation), and the current to used is calculated by making us the figure given for current densi

Thus, if the article has a sur area of 20 sq in, and the cur density is 0.1 amp/sq in, then required current will be 20 x 0 2 amps. The article is suspended the vat with the current switched and the resistance set to its m mum value.

The current is now switched and the resistance gradually creased until the ammeter indic the appropriate value. If it is sired to inspect the article du plating, the current must be switc off before the article is withdra from the solution. If this prec tion is not taken, a very high cur density will be produced at edges of the article and the pla will be marred at these points.

FINISHING

When the plating is completed, article is removed from the bath given a thorough rinse. The pla can now be brought to a high po by the use of a buffing wheel, if this is not obtainable, by the of metal polish on a soft cloth.

Copper is rarely used as a f plating, but is generally used as intermediate plating. Since, h ever, the process and formula quite simple and the chemicals comparatively inexpensive, I h included details of the process so that it can be used as an in exercise in electroplating:

Copper sulphate	4 oz
Sulphuric acid (conc.)	1 oz
Distilled water	2 pin

The copper sulphate is disso in the water and the sulphuric added cautiously while stirring solution.

Plating is carried out at room t perature and the current density ployed should be 0.1 amp/sq in. plating time should be 20–25 minu Two anodes of copper sheet used.

(Continued on Page 111)

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ANSWERS TO CORRESPONDENTS

C. (Redhead, NSW) has recently the Playmaster No. 2 Amplifier and No. 2 Control unit but is having e with slight hum from the con- unit. He has also endeavored to tape adaptor made from a com- al kit but finds the hum very much and wants to know if the Tape tors are suitable for use with the laster Amplifiers.

It should be possible to eliminate ast trace of hum from the control and we suggest that you make this first goal. In the original unit and eat many which have since been to these specifications there has no serious hum problem and you d be able to duplicate these results. probable that the trouble springs a failure to observe the necessary utions with heater wiring and re- layout and shielding. These last- d points are at least as important e circuit itself. We cannot speak experience with the tape adaptor refer to but exactly the same re- would apply. Without proper ing of the input leads to the pre- fier grid, the hum would be in- ble. The Radio & Hobbies tape ors can be used with Playmaster ment, being fed either direct into main amplifier or into the "radio" el. You will note, however, the utions we took to overcome likely les with hum and instability. The approach would be necessary with ape adaptor, no matter how simple ircuit might look at first glance. amplifier book has not been for- .

peful Readers" (Melbourne, Vic. ery keen to obtain some inform- of Geiger Counters and wish t whether we intend to publis details about the devices in the future.

We have no immediate plans for bing such devices but we may do hing about them later on if there rs to be enough interest to justify the meantime we suggest that you t some of the valve manufacturers may be able to supply some liter- on the subject and the use of their Incidentally we would prefer that tters be signed as a mark of good even though we normally only h initials.

G.J.V. (Balmain, NSW) considers that our recent remarks about transformer-less power supplies are slightly dog-matic. He suggests earthing the chassis and making all returns within the se. to a busbar insulated from the chassis. The busbar is bypassed to the chassis by a high voltage condenser and like-wise a condenser is placed in seri with the aerial circuit.

A. Many thanks for your interest. There is nothing new in the arrangement you have suggested, but it can lead to a lot of trouble with modulation hum, when applied to AC receivers or even in DC receivers where the line is a noisy one.

No Name (Sale, Vic.) sends us a rather interesting case for the Serviceman Who Tells and suggests that he may care to make use of it.

A. Many thanks for your letter which, unfortunately, carried no name. We will pass it on to the Serviceman for his possible use at a later date. We have never encountered the difficulty of a valve being soldered into a socket, but it is a good point and worth remembering.

A.L.B. (Molonglo, ACT) is considering building the One Inch CRO and wants to know whether it would be possible to substitute the type 6AL5 for the 6H6 and the type 6X5 for the 6X4. He also suggests a manner in which a seven position switch may be made from a five position type.

A. It appears that there should be no objection to the use of the 6AL5 which is almost identical with the 6H6. Likewise the 6X4 and 6X5 characteristics are similar and should be interchangeable. Many thanks for the suggestion regarding the switch and we may be able to use the suggestion in a later issue.

K.B. (Toowong, Qld.) is baffled by some of the symbols used in the circuit diagrams of our larger receivers. He wonders if we can help him with a booklet explaining this.

A. Our standard sheet explaining circuit symbols is available through the Query Service for 1/-. It should help to clear up most of your difficulties.

E.S.P. (Port Wakefield, SA) is having trouble with a set which he built from a combination of two standard circuits. There were a number of heterodyne whistles over the high frequency end of the range most of which he has removed by shielding the grid leads of the RF amplifier and converter. There is also trouble with interference from the vibrator.

A. The heterodyne whistles must be due to the introduction of some extraneous signal or signals. Faulty alignment of the signal circuits may allow strong signals from the aerial to appear in the converter and beat with the oscillator and/or its harmonics. The cure is to align the set as accurately as possible. On the other hand, when the AVC is inoperative between stations, the gain of the RF amplifier may rise sufficiently to allow it to oscillate due to coupling between the input and output circuits. Signals which are too weak to operate the AVC circuit will then be heard as beat notes. Shielding the wiring as you have done will reduce the efficiency of the amplifier and hence its tendency to oscillate. An additional shield on the oscillator grid would probably have no effect on the whistles other than to alter their position on the dial. The best cure in this case is to improve the layout with particular attention to the grid and plate leads. Shielding should be resorted to only as a last resort. The other trouble you mention is usually described as vibrator hash and is not an unlikely problem in any vibrator receiver. In our standard designs we follow the approved procedure of mounting all the active components in the supply on a single assembly plate making all earth returns to the one point, which is normally formed by a couple of solder lugs under the bolt mounting the vibrator socket. With your particular set the iron cored filter choke is not called upon to filter high frequency ripple and therefore may be mounted outside the shield box.

The plate is then mounted inside the shield box, the active leads being brought out through a grommetted hole, and the earth return being made from the common point already mentioned to another single point on the shielded box. If this procedure is followed, the hash problem will be greatly reduced. According to the design of the set, the vibrator unit box may be attached directly to the chassis or connected to it by flexible wires. In this latter case, it is absolutely essential that the earth return wire be of heavy gauge, and a length of copper braiding is often the best choice. It is worth experimenting in cases of trouble with the earth point chosen for this braiding on the main chassis. The leads from the accumulator through to the vibrator will often radiate hash and it is helpful in some cases to shield at least the lead which is not earthed, and particularly where the lead is taken through an off/on switch in the receiver chassis. In any case, leads to the accumulator should be as short as possible and of heavy gauge. Hash can penetrate a receiver via the filament or heater wiring, and it is worthwhile experimenting with a low tension choke in series with the connection from the "hot" accumulator circuit to the heater wiring. Where the heater wiring is still obviously giving trouble it can often be shielded to advantage. Try a bypass condenser of between 0.1 and 0.5 mfd. from one or other of the heater pins to earth, also at various places on the A plus and B plus circuits. In exceptional cases, an improvement can be effected by shorting out low tension chokes which may be specified in the circuit. An approved laboratory method of testing is to operate the vibrator and filament circuits from independent accumulators to note whether an improvement is effected. If suppression of the heaters from the vibrator circuit completely clears up the trouble, then the obvious need is to devise another method of feeding and filtering the filament supply. On the other hand, if no improvement results from using two accumulators ,then it is fairly evident that the hash is being produced through the high tension or earthing circuits. These are by way of general remarks which apply to all vibrator sets, but they may suggest a method of treatment whic will solve your particular difficulty.

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To those requiring only circuit reprints, &c., we will supply for TWO HILLINGS diagrams and parts lists from our files covering up to three "R & H" nstructional projects. Scale blueprints showing the position of all holes and touts in standard chassis will now be 4/6. These are available for nearly all r designs but please note they do NOT show wiring details.

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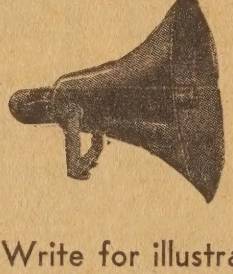

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ECTRO-PLATING

(Continued from Page 108)

is solution can be used repeatedly
the copper deposited on the
ode is replaced by copper dis-
d from the anodes.

though nickel plating requires a
high current density, it is a
ss which can be carried out quite
y and effectively by the amateur
small articles are plated. The
l is softer than chromium and
lating has a warmer color.

el is often used as an inter-
e plating on iron and steel in
eration of chromium plating.

el sulphate, 4oz.
monium chloride, ¾oz.
oric acid, ½oz.
illed water, 2 pints.

he plating bath should be used at
perature of about 90 deg. F.
deg. C.), and a current density
5 amps sq in. The plating time is
to five minutes.

ie anodes should be pieces of
el sheet, one being placed on
r side of the cathode. As with
er, the plating solution can be
repeatedly.

romium is one of the most popu-
netals for plating and there is no
on why successful results should
be obtained by the amateur if
nstructions are followed. In the
of steel and iron, an intermedi-
oating of nickel will be found to
dvantageous.

romic acid, 5oz.
lphuric acid (conc.), 20 drops.
stilled water, 1 pint.

ie operating temperature of the
ng bath should be about 104 deg.
40 deg. C.), and the current den-
0.5 amps/sq in. The plating
is 10-15 minutes. In this case
les of lead are used, and, after a
in amount of usage the bath
become exhausted.

ie quantities given above should
ufficient for plating about 1000
, after which the bath should be
arded.

ie amateur is advised to avoid
r plating for two reasons. First,
s an expensive process, and,
ndly, the chemicals used in com-
ding the bath are of an exceed-
poisonous nature.

an attempt at silver plating is
e, great care should be taken that
plating bath does not come into
act with any cuts or abrasions
he hands.

this juncture it might be well
y that many of the chemicals used
lating are of a corrosive nature
should be kept out of contact
the hands, clothes, and so on. A
e of household ammonia should
ept at hand, and if any of the
ng solution is accidentally spilled,
ping should be preceded by a
al application of the ammonia.
a large quantity of plating solu-
is spilled, it can be satisfactorily
ralised by adding washing soda.
inegar is a good antidote for
tic soda.)

lver nitrate, 1oz.
otassium cyanide, 1½oz.
stilled water, 1½ pints.

ie working temperature of the
is 68 deg. F. (20 deg. C.), and
current density 0.2 amps/sq in.
anodes should be of silver, and
bath will last indefinitely.

pper and brass can be plated
ctly but iron and steel should
ive an intermediate coating of
er before being silver plated.

The processes given above are not the only ones which can be used. Other metals beside copper, nickel, chromium and silver can be deposited electrolytically. It is also possible to deposit alloys, and, by suitable choice of solutions, various grades of brass can be formed.

In general, however, the applications of deposits of metals other than those outlined above, are outside the scope of the requirements of the amateur.

INDUSTRIAL ELECTRONIC AIDS

(Continued from Page 41)

stylus in the amplifier output circuit records each pulse on a chronograph tape opposite pulses similarly recorded by a second stylus operated by a standard time source, such as a seconds pulser.

It is thus possible with the arrangement of Figure 10 to determine very precisely the length of time taken for the meniscus to fall from one constriction to the other and to determine the viscosity of the liquid from this data.

The dielectric constant and power factor of oils are determined by means of a standard cell which is in essence usually a refined two-plate fixed air condenser with suitable, self-contained guard circuit.

DIELECTRIC CONSTANT

Accurate measurements are made of the capacitance and/or the power factor of the cell (condenser) before and after the sample oil has been introduced between its plates—i.e., successively with air and oil dielectric.

The ratio of the "oil capacitance" to the "air capacitance" is the dielectric constant of the sample.

The all-metal test cell utilises its outer metal shell as one condenser electrode and a central metal rod as the other, the oil being poured into the intervening space.

Another refined type of cell consists of a glass sample-oil container into which a cylindrical, concentric-plate air condenser assembly with appropriate guard ring is immersed. Either type may be immersed into a constant-temperature bath during measurements.

For dielectric constant measurements, the test cell may be connected, instead of to a capacitance bridge, to the extremities of the tuned circuit of a highly-stable tunable r.f. oscillator, as shown in Figure 11.

The output of this oscillator is presented to a demodulator and beat-indicator circuit, together with the output of a standard-frequency fixed oscillator. The variable oscillator tuning condenser is a precision instrument which may be read very closely.

The variable oscillator is set to zero beat with the fixed oscillator (with the empty test cell connected). The reading of the tuning condenser is noted. When the sample oil is introduced into the cell, the latter's capacitance will be increased in proportion to the dielectric constant of the oil and the frequency of the variable oscillator will be shifted accordingly.

The variable oscillator is then reset for zero beat and the reading of the tuning condenser noted at this point. The ratio of the "oil capacitance" to the "air capacitance" is the dielectric constant of the sample.

PACKAGING CONTROL

An increasing number of food products is delivered sealed in printed wrappers of paper or other transparent or translucent material. The wrapper material is supplied in large rolls with a repetitive design, and is wrapped around packages, cut, and sealed by machines.

In these machines, the gears which control the rate of paper feed are operated by the same mechanism which propels the rotary knife, and it is endeavored to synchronise the cutting action with the rate of feed in order that the design may not be sliced.

Nevertheless, slipping and creeping of the paper often cause the predetermined cutting point to reach the knife out of time, with the result that the design is clipped or displaced on the package.

In modern packaging machines, this difficulty has been overcome by means of electronic apparatus which controls the paper speed closely to allow a predetermined length to pass through the rollers during each revolution of the knife.

The control index is a small spot printed on the paper in proper relation to the design.

As the paper progresses from its roll through the machine, it passes between a light source and a photocell; and the printed index spot casts a shadow on the cell as it arrives in position varying the latter's output current.

The photocell current variations are built up by an amplifier to operate "speed-up" or "slow-down" relays which advance, retard or "neutral" a variable-speed paper-feed motor, depending upon whether the index spots arrive over the photocell early, tardily or on time.

DRAWING WIRE

It is essential in wire-making that the wire be drawn through the last die at constant speed and tension. Before the advent of automatic devices for the purpose, it was imperative that this final operation be skilfully attended.

The basic elements of an electronic circuit now employed to control speed and tension in the last stage of wire-drawing is shown in Figure 12. A Thyratron tube arrangement controls the speed of the motor that winds the wire on its reel.

Variations in speed and tension cause the movable pulley to be displaced vertically and to move a plunger within a solenoid coil. The latter is connected to the Thyratron grids.

Movement of the plunger effectively alters the inductance of the tube grid circuit and the tube output voltage is in turn altered accordingly. This variable voltage is then impressed upon the armature of the reel-turning motor. The speed of this motor is varied from zero to maximum by a plunger movement of only a few inches.

(By courtesy of Aerovox Corporation.)

To Be Continued

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Cost of Classified advertisements in this section is 2/- per line, approximately five words to a line. Closing date for January issue of Radio and Hobbies is Wednesday, December 9.

FOR SALE: Williamson amplifiers, £20 and £25; turntables, record players and changers, £3-£7. **Mote, 15 Onyx Rd., Artarmon. XL4138.**

FOR SALE: Production unit, complete, portable 7 Channels' meter monitor speaker, used for radio progs., excel. condition. Sell cheap. What offers? **Les Nixon, LA4572 (Bus.).**

SALE: R. & H. 5in Cro., unused, £20. **R. Glover, 9 Melville Av., Cabramatta.**

SELL: BC 348Q Comm. Recr., 200 Kc. to 18 Mc. 240 AC (10 valves and LS), £27. Amer. ARB Comm. Recr. 195 Kc. to 9 Mc. 240 AC (8 valves and LS), £20. Both as new with handbooks. Best offer accepted. **O'Brien, 181 Barkly St., Nth. Fitzroy, Vic. JW1897.**

SELL: University Signal Tracer, £10. Cosmocord Crystal Pickup, 30/-. Valves as new, two 53's, one 2A3—one 6W5, all 10/- each. **Wilson, 20 King Edward St., Rockdale, any evening.**

SELL: B.R.S. Magnofilm Deck for sale. £25, offer. **Grinstead, Woonga Dve., Ashgrove, Brisbane.**

SELL: 70 R. & H., Vol. 9, No. 1, April, 1947, to Vol. 14, No. 8, Nov., 1952. Offer. **Harford, 55 View St., Gunnedah, NSW.**

SELL: New Speaker, Rola, 12K, Trans., 55/-. **Coote, 18 Glenayr Ave., Bondi.**

SELL: Complete set R. & H. except Vol. 6 No. 7 and Vol. 8 No. 5. Separate if required. **38 Downshire Rd., Elsternwick, Vic. LF7390.**

SELL: Transceiver and Power Pack Type FS6 for sale, condition new. Inspect at **28 White Av., Lockleys, South Aust.**

SELL: A R. & H's Carry Set in working order, less batteries, £10. **Ian Lees, "Kia-Ora," Gundaroo, NSW.**

SELL: Disposal valves, some new, all guaranteed; 12AH7, 6SH7, 5/- each; 12A6, 12C8, EF50, 6/- each; 6SS7, 9002, 9003, 6G6, 12H6, 6K7, 6N7, 7/- each; 6SN7, 8/- each. Lots of three or more, less 1/- each. Crystals in holders, useful harmonics, 15/- each; others, 7/6 each. Post free. **A. Jacka, Box 51, Bairnsdale, Vic.**

SELL: R. & H. 1946-1951 comp. Best offer or exch. multimeter. **FY4124, Sydney.**

WANTED: Multimeter. State price. **Barry, 94 Glover St., Mosman.**

WANTED: Exponential Speakers, complete, also Speaker Units, any condition, also 809 Valves. Reply **Barber, 15 Whitlock St., Kalgoorlie, W. Aust.**

WANTED: 50 Mc. Coil Box for Kingsley K/S9er. **C. Thorpe, Dawson Rd., Rockhampton, Queensland.**

EXCHANGE: B.R.S. RI2 Recording Unit for BC.348, AR7, AR8, Receiver or similar type. **B. R. Forbes, 28 Knight St., Shepparton, Vic.**

WANTED: Used single gang .0005 and .0001 mfd, variable condensers; also used phones in reasonable condition. Prices to **Science Master, High School, Orange, N.S.W.**

Pocket Book STORYTELLER WEEKLY HAS THE PICK OF THE WORLD'S BEST STORIES

Remake your old se

(Continued from Page 85)

picked out in a dark enamel. the passage of time, the lacquer h developed fine cracks and the ca enamel had been freely chipped.

The correct procedure in such case is to sand the original fin right off, then proceed to re-stain a repolish. Since this calls for a go deal of skill and a lot of time, t writer adopted a much quicker sho cut method.

The cabinet was first rubbed with very fine emery paper to sm down the tiny ridges where lacquer surface had cracked. can keep a check on how the surf will look when re-lacquered simply moistening critical spots w water on the tip of a finger.

To give the surface a light tou up overall, we rubbed it over "frer polish style" with a pad moisten in raw oil and a light spirit stai

The previously painted edges re-done with a chocolate ena and left to dry. Next evening, went over the whole surface with coat of clear synthetic lacquer. Th with a new piece of grille clo completed a transformation th matched up to the obligation of hou ing a rebuilt chassis.

As we said at the outset, y mightn't make a living doing kind of thing but it's reward enou to receive the gratitude of a m whose eyes look but never see!

SELENIUM FROM WEE

A RELATIVELY rich source of scarce chemical element sel ium has been discovered in "l weeds" that poison cattle.

Artificial growing of this pea herb may prove to be a practi way of creating a "weed mine" a producing the chemical, import in the electronics, petroleum a rubber industries.

Even if the soil in which the loc weeds grow does not contain suffi ient selenium to make direct extra tion economical, the plant blots the element and concentrates it its tissues. As much as 1.5 pc sele ium by weight is contained in plant in soil that contains on 0.005 pc of the chemical.

At present selenium is a by-pr duct of the electrolytic production copper and the supply is inadequa

KNOW HOW T

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